CALIFORNIA STRAWBERRY COMMISSION

PEST MANAGEMENT EVALUATION for

Strawberries in California

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An Evaluation of Soil-Borne Pest Management for Strawberries in California in the Absence of Methyl Bromide

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ABSTRACT:

CALIFORNIA STRAWBERRY COMMISSION

PEST MANAGEMENT EVALUATION For Strawberries in California

California produces 80% of fresh market strawberries. These strawberries are grown on roughly 23,000 acres per year and have an estimated annual value of 580 million dollars. For most of this century, the strawberry industry has relied on both chemical treatments and cultural practices to treat soil borne diseases, insects and weeds so that these pests would not significantly impact the fruit yield and/or quality. One of the tools that the industry has heavily relied upon is methyl bromide, a broad-spectrum soil fumigant, applied in combination with chloropicrin.

Methyl bromide has properties that have been identified as being problematic to both the environment and public health and it will therefore be phased out by the year 2001. There are no broad-spectrum soil fumigant options currently available to the strawberry industry that are ready for widespread use and will fully replace the control provided by methyl bromide. The continued economic success of the strawberry industry in California will be based, in part, on the industry's ability to develop a pest management program that balances cultural and biological control practices with chemical treatment.

This document discusses the current pest management program used by the strawberry industry, including cultural practices, biological control and chemical treatments. It also discusses potential reduced risk pest management practices that may help the industry address the impending challenges from the loss of the industry's key pest control tool, methyl bromide.

CALIFORNIA STRAWBERRY COMMISSION

PEST MANAGEMENT EVALUATION For

An Evaluation of Soil-Borne Pest Management for Strawberries in California in the Absence of Methyl Bromide

I. INTRODUCTION:

California is first in strawberry production in the United States, producing 80% of fresh market strawberries. These strawberries are grown on roughly 24,000 acres per year and have an estimated annual value of approximately 580 million dollars. The continued economic success of the strawberry industry in California will be based, in part, on the industry's ability to develop a pest management program that balances cultural and biological control practices with chemical treatment.

For most of this century, the strawberry industry has relied on both chemical treatments and cultural practices to treat soil borne diseases, insects and weeds so that these pests would not significantly impact the fruit yield and/or quality. In recent decades, one of the tools that the industry has heavily relied upon is methyl bromide, a broad-spectrum soil fumigant, applied in combination with chloropicrin. The mixture of these two fumigants has proven highly effective due to the unique ability of methyl bromide to penetrate the soil and "find" adverse soil-borne pests as well as the higher fungal toxicity of chloropicrin. Pre-plant applications control many soil borne diseases, including most agronomically important diseases, prevents weed germination, and kills arthropods that may be present in the soil. In addition, methyl bromide is used as a pre-plant soil fumigant in both the nursery and the field as a means of protecting the strawberry stock from infection and infestation.

Though methyl bromide is an effective pest management tool that currently is crucial to the agronomic practices of California's strawberry industry, the compound has properties that have been identified as being problematic to both the environment and public health. Methyl bromide has been identified as having the potential to deplete the Earth's ozone layer, and has become highly regulated and is being phased-out. Domestic production of methyl bromide has been frozen at 1991 levels and the importation and production of methyl bromide will cease by the year 2001. There are no broad-

spectrum soil fumigant options currently available to the strawberry industry that are ready for widespread use and will fully replace the control provided by methyl bromide.

The use of methyl bromide as a key pest management tool has resulted in relative economic stability for the California strawberry industry for many years. With the impending loss of methyl bromide as a pest management tool, the strawberry industry faces the challenge of developing a sound, multi-faceted, reduced-risk approach to integrated pest management that will provide viable biological controls, cultural practices and chemical tools for disease, insect and weed control.

II. SUMMARY OF INFORMATION REGARDING PEST COMPLEXES:

Hectarage of production strawberries in California has increased by over 78% from 5,666 hectares in 1985 to 10,117 hectares in 1996. Strawberry production in California occurs primarily along the central and southern coast, with a small amount in inland areas. These areas can be divided into five different growing regions: Central Coast, Santa Maria Valley, Oxnard Plain, South Coast and the San Joaquin Valley. Although each of these regions has unique growing conditions (e.g.: weather, soil conditions), growers face many of the same pest problems.

The table entitled Pest Management Evaluation Guide (Appendix 1) summarizes the crucial pests impacting California's strawberry industry and the cultural, biological and chemical methods that are available for managing these pests. The relative efficacy and economic viability of these methods are summarized in the table and detailed in the following sections of this document. Appendix 2 encloses a copy of the 1996 Pest Management Survey Database for strawberries in California. This Database was developed jointly by the UC Statewide IPM Project and the Department of Pesticide Regulation.

DISEASES. Diseases are potentially serious economic problems in all strawberry growing areas within the state of California. The impact of the disease depends on regional weather and soil conditions, quality of planting materials, and cultural practices. Coastal areas and nurseries tend to have cool, damp conditions that are favorable for disease development. Plant diseases involve complex interactions of causal agents, host plant and environmental factors. The use of good cultural practices, certified transplants, and soil furnigation has allowed the strawberry grower to minimize the impact of plant diseases.

Diseases are generally identified by the part of the plant that is infected. The most agronomically important diseases are listed below. Complete descriptions of each disease are enclosed in Appendix 3. These descriptions are summaries of these pests and their management that have been developed by the UC Statewide Integrated Pest Management Project.

Fruit Disease:

Anthracnose

Botrytis Fruit Rot (Gray Mold)

Rhizopus Rot (Leak)

Mucor Fruit Rot

Leather Rot

Powdery Mildew

Foliar/Crown Disease:

Angular Leaf Spot

Anthracnose

Common Leaf Spot Powdery Mildew

Leather Rot

Root/Crown Disease:

Anthracnose

Phytophthora Root and Crown Rot,

including Red Stele Root Rot

Verticillium Wilt

Black Root Rot

The use of good cultural practices is critical in the management of disease. These practices include field selection, raised beds, the use of certified stock, use of resistant cultivars, use of drip irrigation, the removal and destruction of dead leaves and fruit from strawberry plants, the use of plastic mulches to prevent berry-soil contact, good sanitation methods during harvest, packing, transport and storage, and crop rotation with a non susceptible crop.

Research related to soil solarization and hot water treatments is underway. Solarization is a technique in which heat generated by solar radiation on clear plastic covered moist soil kills soilborne pathogens, nematodes, and weed seeds in the upper 2 to 6 inches of the soil. The technique appears to have more potential in central valley growing areas where solar radiation is highest and

the relatively long crop-free period required for solarization is consistent with the region's cultural schedules. Solarization may also be useful in other inland locations, but along the coast clouds, fog, or wind prevent adequate solar heating of the soil. Because solarization generated heat only penetrates 2-6" deep, it may need to be combined with other control methods, such as fumigation of the deeper soil profile. The effectiveness of fumigants, such as methyl isothiocyanate (whether generated from the use of Vapam, or from crop residues), may be increased when used in combination with soil solarization.

Hot water dipping of bare-root strawberry plants in nurseries can reduce nematodes and some diseases. This method, however, cannot be used for transplants intended for fruit production in fields because plant vigor is reduced substantially by the hot water treatment.

Chemical treatment begins with a pre-plant fumigation of the soil with methyl bromide and chloropicrin to reduce the innoculum of potentially serious strawberry diseases. This pre-plant fumigation also significantly increases yields and quality by impacting plant pathogens of unknown identity. Virticillium wilt and Phytophthora root rot are usually not problems in fields that have been fumigated properly. Pre-plant fumigation plays an important role in managing anthracnose and common leaf spot. Fumigation, however, does not kill all pathogen populations, so they will increase to levels sufficient to cause damage if pre-plant soil treatment is not repeated on a regular basis. Fungicides, such as benomyl, iprodione and vinclozolin to control above ground diseases (e.g.: anthracnose, powdery mildew, botrytis fruit rot), must be applied before infection occurs or when the disease just begins to develop. Resistance problems are a major concern when it comes to fungicides, so applications of these types of products are made when conditions indicate that control action is needed. Different types of products are usually applied when repeat applications are needed, to avoid resistance development.

INSECTS AND MITES. A variety of insect and mite pests occur in California strawberries, some are beneficial predators or parasites of insect pests, but others are destructive and can cause yield decreases and/or fruit grade reductions. The importance of mite and insect pests depends on the location, harvest season, market destination of the crop, and whether strawberry plants are held over for a second year of production. Insects and mites usually are damaging when their feeding kills plants or reduces the supply of nutrients available for fruit production. In some cases fruit quality is reduced by diminished size, contamination, scarring, or growth distortion. Insects

identified as pests of concern for the strawberry industry in California are listed below. Complete descriptions of each of these pests are found in Appendix 4 which is comprised of summaries developed by the UC Statewide Integrated Pest Management Project.

Aphids Garden Tortrix
Beet Armyworm Lygus Bugs
Cabbage Looper Root Weevils

Corn Earworm Saltmarsh Caterpillar
Cutworms Twospotted Spider Mite
Cyclamen Mite Western Flower Thrips

European Earwig Whiteflies

Garden Symphylan

Many insects and mites found in strawberry fields are beneficial predators or parasites that help suppress the pest populations. Predatory mites and parasitic wasps tend to attack only a single pest or a few types of pests, but can play an important role in keeping those pests under control. When pesticide applications are needed, products that are least harmful to the predatory insects are selected whenever possible.

Cultural practices are critical in controlling the insect population within a field. Many insects are attracted to weeds or debris, therefore, removal is necessary. Other cultural practices include field selection, avoiding second year plantings, pre-plant hot water bath for infested stock, sorting out contaminated berries. Recently, research on suction devices used to vacuum insects have been tried on lygus bugs with some success; however, there is concern that vacuums may increase existing problems with powdery mildew and gray mold. Solarization may be effective in controlling soil-dwelling arthropods, although more research is needed.

WEEDS. Strawberries are highly susceptible to weed competition immediately after planting when the plants are small and frequent watering provides ideal conditions for weed germination. Most weeds invading strawberry fields are annuals. Effective weed management in strawberries requires a combination of cultural practices, pre-plant soil fumigation, and additional herbicide applications. Appendix 5 encloses the UC Statewide Integrated Pest Management Project's summary of "Integrated Weed Management" for strawberries. The University of

California's publication, "Integrated Pest Management for Strawberries", also identifies and details the most important weed pests of strawberries in the different growing regions in California. A summary of their findings is as follows:

Central Coast	Santa Maria Valley	Oxnard Plain	South Coast	Interior Valleys	No. California Nurseries
little mallow burclover common groundsel sowthistle purslane chickweed filaree burning nettle bluegrass	little mallow burclover chickweed filaree	little mallow burclover shepherd's purse chickweed burning nettle	mallow sweet clover filaree lambsquarter pigweed shepherd's purse	barnyardgrass pigweed lambsquarter purslane sowthistle cudweed horseweed hairy fleabane crabgrass shepherd's purse	mallow sweetclover filaree vetch sowthistle

It is critical to keep weeds from getting established and out competing the young strawberry plants. Thorough hand weeding is labor intensive and expensive but is an alternative to chemical treatment. Other cultural practices include field selection, crop rotation and the use of opaque mulches, or IR selective films. Opaque polyethylene mulch greatly reduces weed growth in planting beds, however, it delays fruit production and can burn fruit when temperatures are above 90°F. Solarization is being researched as an alternative to pre-plant fumigation. It can be effective in areas where strong sunlight and high air temperature allow soil heating to a sufficient temperature to kill weed seeds and shallow growing perennials, such as bermuda grass rhizomes and nutsedge tubers.

Chemical weed treatment typically consists of a broad spectrum pre-plant fumigation containing methyl bromide. Even with pre-plant fumigation, windblown seeds resulting in weeds present a considerable problem to the strawberry grower. Herbicides, such as paraquat, DCPA, and sethoxydmim may play a role in managing weeds within a field; however, to avoid phytotoxic effects to the strawberry plants care must be taken in the application of such products.

NEMATODES. Damage from nematodes may result in plant stress and reductions in yield. Plant parasitic nematodes are microscopic, unsegmented roundworms that may be found in

the soil, as a parasite in roots, or aboveground on plant parts. The use of certified stock (produced in fumigated fields) combined with pre-plant fumigation with methyl bromide has been the primary management technique to date. The most common nematodes identified as pests in California strawberry fields are detailed in the UC Pest Management Guidelines (Appendix 6). The most common nematode pests are the following:

Foliar Nematode
Northern Root Knot Nematode.

Steps are taken by the strawberry industry to reduce the chance of nematode infestation. These practices include selecting tolerant cultivars and certified nursery stock, by analyzing field samples, and by taking steps to clean equipment to prevent the transfer of nematodes from an infested field to a clean field. Other cultural practices include planting when conditions are unfavorable for nematodes, crop rotation including fallow, and biological control.

Chemical treatment of nematodes begins with pre-plant soil fumigation with methyl bromide. Pre-plant applications may also be made with metam sodium, although steps must be taken in the application method to insure that this material get to the target organism. Oxamyl is registered for use on root knot and lesion nematodes on nonbearing nursery stock only, although some incidence of phytotoxicity has been reported for certain cultivars. 1,3-D (Telone II or Telone C35) has been demonstrated to be very effective against nematodes, but is not typically used by growers in California at this time due to severe restrictions related to the use of the products near urban areas (e.g.: rate restrictions near townships and buffer zones).

III. PEST MANAGEMENT ACTIVITIES AND PRACTICES:

California's strawberry industry relies on a combination of approaches to pest control. Biological control, cultural practices, pre-plant fumigation and chemical treatments are each components of the current pest management program. While cultural practices and biological controls are important facets of the pest management program, these non-chemical practices alone would not allow California growers to continue producing high quality fruit at a sufficient yield to remain both competitive and economically viable. The industry has relied on pre-plant fumigation with methyl bromide, in combination with chloropicrin, to control soil borne diseases, prevent weed germination, and to kill arthropods present in the soil. This broad spectrum fumigant has been used

in conjunction with cultural practices and biological control to provide a strong first defense in the control of pests common to strawberries. After planting, growers continue to utilize biological controls, such as natural predators, and cultural practices, such as field sanitation techniques to minimize the need for chemical treatments. However, it is in large part the use of chemical treatments, such as methyl bromide, that has resulted in relative economic stability for the California strawberry industry.

PRE-PLANT FUMIGATION. Pre-plant fumigation with Methyl bromide, used in combination with chloropicrin, is used throughout all of California's growing regions on almost all strawberry fields as well as in all nurseries during their propagation of planting strawberry stock. No single synthetic chemical or non-chemical option or any combination of practices and procedures has been found that can replace the efficacy of methyl bromide/chloropicrin broad-spectrum applications. The methyl bromide/chloropicrin pre-plant fumigation combination has proven efficacious for the following pests, as reported by the UCD Integrated Pest Management Program:

Arthropods: Root weevils, cutworms, strawberry rootworm, white

grubs, garden symphylan, ground mealybug.

Diseases: Soil borne fungi that cause verticillium wilt,

Phytophthora root and crown rots, anthracnose, black root rot, charcoal rot, and other soil-borne pathogens of unknown etiology that impact strawberry plant

yield and quality.

Nematodes: Foliar nematode, Root-knot nematodes

Weeds: Seeds in all species except field bindweed, little

mallow, burclover, sweetclovers and filaree.

OTHER TREATMENTS. Treatments with fungicides, insecticides and herbicides are applied to fields based on existing, increasing or potential pest pressures. Many diseases overwinter in fields, which is why pre-plant treatment with methyl bromide is important to control disease pressure. Appendix 1 is a table summarizing non-chemical and chemical treatments used by the strawberry industry as taken from information available from the UC IPM Program, the DPR

Survey and input from Pest Control Advisors.

Diseases, such as anthracnose which develops under warm or cool moist conditions, and Botrytis fruit rot (gray mold) which is prevalent in cool weather, can significantly reduce fruit yield. Captan and Benomyl are most commonly used by growers as a preventative treatment to control the outbreak of anthracnose. Repetitive treatments of vinclozolin, iprodione, Captan or thiram are used to treat Botyrtis fruit rot, a major fruit rot disease of California strawberries. Pest resistance to fungicides is a common problem that must be faced by growers utilizing chemical. Growers alternate chemicals, such as iprodione and vinclozolin with other products to minimize the potential for pest resistance.

Damage to strawberry plants and fruits from insects can be significant to growers throughout the state. Two-spotted spider mites and lygus bugs are two pests that can severely impact the quality and yield of strawberries. Damage from two-spotted mites to strawberry plants is heaviest during the first four months following planting and is seen as stippling, scarring and bronzing of the leaves and calyx. Avermectin is very effective in controlling two-spotted mites, but is expensive and requires multiple tratement. Other products registered for use, such as dicofol, febutatin oxide and potash soap, all have disadvantages including pest resistance, variable efficacy and phytotoxicity under certain conditions. Pest resistance to dicofol has been seen, which makes growers reluctant to use this product against two-spotted spider mites because it is one of the few products effective against cyclamen mite, and they would prefer to use this tool when it is needed for that pest.

Lygus bugs are a serious pest in the central and south coast growing regions, damaging seeds causing irregularly shaped strawberries. Lygus bugs are only susceptible to chemical treatments during the first or second instars. Growers commonly apply naled, malathion and methomyl to control young nymphs.

BIOLOGICAL CONTROLS. Biological Control is defined as the activity of any organism (parasite, predator, pathogen, antagonist, or competitor) that keeps a pest or pathogen population lower than it would otherwise exist. These organisms may be used to prevent infection or as colonists of the infected tissues to arrest pest or disease development.

Natural Enemies. Natural enemies contribute to the control of many insect and mite pests of strawberries.

NATURAL	ENEMIES OF STRAWBERRY PESTS IN CALIFORNIA
Pest	Biological Control Agent
Two-spotted spider mite	Predatory mites: Phytoseiulus persimilis, Galendromus (metaseiulus) occidentalis, Amblyseiu (neoseilus) californicus; six-spotted thrips; spider mite destroyers; minute pirate bugs; bigeyed bugs; lacewings, dusty wings, damsel bugs, predatory midges
Lygus bug	Parasitic wasps: Anaphes iole (A. ovijentatus), Leiophron uniformis; bigeyed bugs; damsel bugs; minute pirate bugs; spiders
Cyclamen mite	Predatory mites: Amblyseius (neoseilus) aurescnes, A. (N.) cucumeris, Galendromus (Metaseilus) occidentalis; six-spotted thrips, minute pirate bugs
Aphids	Parasitic wasps: Lysiphlebus testaceipes, Aphidius, Aphelinus; fungal disease: Entomophthora; lacewings; bigeyed bugs; minute pirate bugs; dusty wings; damsel bugs, lady beetles
Caterpillar pests	Parasitic wasps: Trichogramma, Macrocentrus, Hyposoter, Copidosoma, damsel bugs; bigeyed bugs; lacewings; minute pirate bugs; nuclear polyhedrosis virus
Whiteflies	Parasitic wasps: Encarsia, bigeyed bugs; minute pirate bugs; lacewings

When evaluating needed pest control measures, the pest control adviser and the grower try to maximize the benefits of biological controls whenever possible, turning to chemical treatments when pest populations are no longer managed by biological controls or are expected to increase and cause significant crop damage. When treatments are necessary, growers give consideration to the beneficial insects and mites and select products carefully in an attempt to maintain as high a population of these beneficial biological control agents as possible.

CULTURAL CONTROLS. Good cultural practices, from field selection through handling of harvested fruit are essential to all growers for maximum yield of high-quality California strawberries. Many cultural practices have a significant effect on pest control. The following is a brief discussion of cultural practices common to most growers.

Field Selection. Deep, well-draining, sandy loam soils are best for strawberry production. The field should be easy to grade and have good air drainage so that cold air doesn't settle on the field. An adequate supply of good-quality water should be nearby. Soils are tested for salinity, and records of previous crops and herbicide use are reviewed.

Cultivar Selection. Strawberry cultivars are developed based on several factors including desired day length, and vigor. Cultivars vary in their susceptibility to some pests and abiotic disorders. Shifts in cultivar selection by growers has occurred in recent years. Central coast strawberry producers have shifted from exclusively summer-planting short-day cultivars (i.e. Tioga, Aiko, Tufts, Douglas and Pajaro) to primarily fall-transplanting the day-neutral cultivar "Selva. During the 1980's southern California strawberry producers shifted from later October or early November cultivars to early October transplanting of "Chandler", which was recently replaced by "Camerosa". The University of California's publication, "Integrated Pest Management for Strawberries" describes the characteristics of strawberry cultivars commonly grown in California as follows.

CULTIVAR	DAY LENGTH	PLANTING SEASON	COMMENTS & POTENTIAL PROBLEMS
Chandler	short	winter summer	somewhat tender skin
Douglas	short	winter	early production, potential for albino fruit, soft fruit in warm weather
Irvine	neutral	winter	early production; more susceptible to mites if vigor inadequate; more susceptible than short-day plants to powdery mildew
Muir	neutral	winter summer	more susceptible to mites if vigor inadequate; more susceptible than short-day plants to powdery mildew
Oso Grande	short	winter	albino fruit, splitting
Pajaro	short	summer	long season; susceptible to rain damage
Parker	short	winter	early production; susceptible to weather damage
Seascape	neutral	winter summer	more susceptible to mites if vigor inadequate; more susceptible than short-day plants to powdery mildew
Selva	neutral	winter summer	more susceptible to mites if vigor inadequate; more susceptible than short-day plants to powdery mildew

Sanitation. To help keep a field free of pathogens, soil-dwelling insects and weeds, growers utilize the following sanitation practices in addition to soil furnigation:

- use high-quality, certified pathogen-free transplants
- allow time between crops so that crowns from the previous strawberry crop are completely decomposed
- work cleanest fields first rinsing equipment with plain (hot) water to remove soil and plant debris before working another field,
- remove weeds from in and around the field before they produce seed
- ensure that manure or other organic amendments added to the field are properly composted or sterilized.

Crop Rotation. Strawberry fields are sometimes rotated with a cover crop, such as rye or barley, or with another cash crop, such as beans or broccoli, to reduce pest populations and improve soil structure. In areas where land costs are high, such as the south and central coast, planting non-cash cover crops are not economically feasible. Cash-crop rotation needs time to be effective, and the crop rotated into the field is often not as profitable as strawberries resulting in economic loss to the grower. Growers are sometimes reluctant to rotate crops because the value of the land is so high that a high value crop, like strawberries, is necessary to offset land and farming costs, or because they do not possess sufficient land to rotate crops. In addition, some soil-borne pests can survive for years in the soil which could reduce the success of a crop rotation program.

Cultural Practices and Field Preparation. Decisions related to various cultural practices are made daily by growers. Decisions related to field selection, soil nutrient supplements, and cultivars are made well in advance of planting. The growers design planting beds to allow proper drainage and irrigation. Time is allowed from one crop to another to allow any residues from previous treatment to decompose. Soil supplements and nutrients are added to fields to prepare soil for planting and sustaining crop. These are practices common to all growers. Clean tillage, raised beds, plastic mulches and water management are all important aspects of a systems approach practiced by California strawberry growers.

SYSTEMS APPROACHES. The California strawberry industry currently practices a pest management strategy that encompasses cultural, biological and chemical components. Cultural practices, such as field selection and preparation, use of certified plant stock, good soil preparation, bed design, field sanitation and crop rotation are critical components of the strawberry Industry's current and future pest management system. This system could reduce the need for conventional pesticides and/or lead to reduced rates of chemical treatment in the field.

IV. REVIEW OF PEST MANAGEMENT OPTIONS BEING CONSIDERED THAT MEET REDUCED-RISK OBJECTIVES:

Methyl bromide, a key component in California's strawberry industry pest management programs, has been determined to contribute to ozone depletion and will no longer be produced after 2001. As discussed in the previous sections, methyl bromide is a broad spectrum soil fumigant, and no other chemical or non-chemical tool has been identified that will replace it fully. The strawberry industry is currently researching new practices, both cultural and chemical, to identify effective reduced-risk pest management programs that will be able to replace the industry's use of methyl bromide. California's strawberry industry recognizes the need to become less reliant upon chemical treatments and to develop sound practices that will enhance pest control with as little chemical treatment as possible, yet maintaining fruit quality and yield. The industry's goal is to develop a pest management program that will encompass cultural, biological and chemical treatments to provide growers with the safest possible tools for continued economic success in the market. Due to the potential adverse impacts of methyl bromide on the environment and public health, the adoption of any pest management tool or program designed to substitute for the current reliance on methyl bromide would result in significantly reduced-risk.

The California Strawberry Commission together with experts from the United Stated Department of Agriculture, the University of California, and California's Integrated Waste Management Board have examined existing and new treatments that could reduce risks to workers, growers, the general public, and the overall environmental. These reduced risk components of the pest management system focus on cultural practices and application techniques. These components are the focus of the accompanying Pest Management Alliance Work Plan.

- 1. Soil Solarization This technique involves covering moist soil with clear plastic and allowing the solar radiation to heat the top 2 to 6 inches of soil to temperatures high enough to kill soil-borne pathogens, nematodes and weed seeds. Solarization is seen as a potential alternative to soil furnigation or as a supplement to furnigation thus allowing lower use rates for furnigants. Solarization has the greatest potential for use in the central valley growing areas, where solar radiation is highest; although there may also be a potential for use in inland locations along the central coast where clouds, fog or winds do not prevent solar radiation from adequately heating the soil. Additional research is needed to define the conditions under which solarization will contribute to the pest management program and, if proven to be consistently effective, to educate the grower community to the benefits of solarization.
- 2. Crop Rotation Crop rotation can be an effective method in suppression of disease and/or pests to annual crops. Strawberry fields are rotated with a cover crop, such as rye, barley and bell beans, or cash crops such as broccoli to enhance pest control and help improve soil structure. Cover crops enhance the health of the soil and can help suppress disease, but represent an economic loss to the grower. Crop rotation needs time to be developed into an effective pest management tool. The crop rotated into the field is often not as profitable as strawberries resulting in relative economic loss to the grower. Factors such as economic impact, disease control, and pesticide label restrictions need to researched and optimal parameters established in the development of this method of pest management.
- 3. Organic Amendments/Mulching. Organic amendments can be incorporated into the soil to improve the quality of the soil, and can be used on the soil surface to provide a barrier to help keep fumigants from escaping. With the help and guidance of the expertise within the California Integrated Waste Management Board, the California strawberry industry proposes to investigate the impacts of utilizing organic amendments or mulches from various specific waste streams established by the Board's authority on pest control. This use of California's unique, statewide waste management to focus on possible reduced-risk alternates to pesticides, is an innovative use of our state's resources.

- 4. Reduced-Risk Application Methods. With the assistance of our team members, several alternate application technologies are being proposed to dramatically reduce the potential harms from any future use of soil-borne pest controls. The following techniques are being evaluated:
 - Sub-Surface Drip Irrigation Systems. Potential exposures and furnigant releases resulting from direct injection of pesticides could be significantly reduced through the use of sub-surface drip irrigation systems. The treatments being considered in this reduced-risk alternate to existing delivery techniques are:
 - relone C35 EC. 1,3-D is almost as effective as methyl bromide as a broadspectrum fumigant. It is not, however, used by most California growers due
 to restrictions associated with amounts allowed/township and buffer zones.
 A new emulsifiable concentrate formulation, not currently registered for use
 in California, when applied via sub-surface drip irrigation shows great
 promise in the control of air emission and efficacy and may allow for future
 use of this effective tool. Preliminary research in Texas has indicated that
 applications of the EC formulation through drip irrigation effectively controls
 air contamination reducing potential risk and exposure to applicators, growers
 and the public. More research under California conditions is needed to
 determine if this is a viable tool that could bridge the gap left by the loss of
 methyl bromide, while new pest management practices are proven effective
 and are made available to the California strawberry industry.
 - Biological Control Agents. Biological control agents are typically water suspendable and application via sub-surface drip irrigation systems may be a practical way to deliver these agents to the field. Research on biological control agents is new and more will have to be known about the efficacy of individual agents before field applications are made.
 - Chloropicrin and Vapam. These traditional pesticides may also benefit from solubilization in water and sub-surface drip irritation delivery systems..

- O High-Barrier Films. These high barrier films which are essentially impermeable to the crop protection chemicals being usedentrap the soil-applied fumigant until it degrades, thereby reducing the emission from the fumigant, and may allow for reduced application rates of the fumigants since the material is held longer in the soil.
- O Chemical and Organic Barriers. These chemical or organic barriers are supplements to plastic barriers and may be the pragmatic means to significantly reduce the potential risks of soil applied products.
- Soil Conditions. Experimentation is underway to identify the optimal soil conditions for reducing emissions and other potential hazards associated with treatments of soil-borne pests.
- O Application Rates. Research is being performed to enhance the industry's understanding of the minimal rates needed for agronomic efficacy.

V. PEST MANAGEMENT CHALLENGES:

The California strawberry industry has achieved relative economic stability in recent years, with an estimated annual crop value of \$580 million dollars, due in part to current pest management practices which rely heavily on the use of methyl bromide/chloropicrin treatments to control soil borne diseases, insects, and weeds. The problem facing the industry today is the impending loss of methyl bromide in 2001, a key component of the current pest management sytem. The industry faces the primary challenge of developing an effective, viable pest management program that will promote continued economic stability for the California strawberry industry.

The industry is developing a long-term pest management program that will couple reducedrisk chemical treatments with cultural practices, such as the use of high barrier films and solarization to achieve pest control. Efforts to determine the effectiveness and viability of these approaches is underway, although it could be several years before these pest control techniques become common cultural practices.

For the California strawberry industry to maintain an economically viable level of

production, it must face the short term challenge of finding a reasonably effective reduced-risk chemical treatment program that will not harm the ozone, threaten worker or public health, and will allow for the continued production of quality fruit. The long-term challenge faced by the industry is the development of a systems approach that can reduce the industry's use of and dependence on chemical treatments (by reducing rates of application, and/or the need for treatments) and increase the industry's reliance on reliable cultural practices, such as high barrier films, solarization, organic soil amendments, and crop rotation, used either alone or as a supplement to reduced-rate chemical treatments. Research to determine the efficacy of reduced risk chemical treatments (e.g.: subsurface drip irrigation techniques) and cultural practices, alone and in combination are needed before these practices can be recommended to and implemented by growers.

Grower dependence on methyl bromide/chloropicrin is high, as there are currently no other broad-spectrum soil furnigant options available to the strawberry industry. The need for an efficacious control program to replace methyl bromide is critical to the industry. Challenges facing the industry include the identification of effective reduced-risk chemical treatments, the development of viable cultural controls, and grower acceptance and implementation of new practices.

The strawberry industry has reviewed both chemical treatments alone and in combination with cultural practices that have the potential to replace methyl bromide after it has been phased out, and has developed a work plan to address the industry's future needs for effective, economical chemical and non-chemical tools.

Reduced Risk Chemical Treatments. Methyl bromide is a toxic air contaminant that is a Toxicity Category I pesticide bearing the signal word "DANGER". It is a colorless, odorless gas that can potentially cause respiratory distress, cardiac arrest and central nervous system effects. It is highly regulated, restricted-use pesticide that can only be applied by teams of certified applicators. One pesticide that is an effective alternative to methyl bromide is 1,3-D. 1,3-D is currently registered as a restricted-use pesticide (Telone II, Telone C35) that is highly regulated and also identified as a toxic air contaminant in California. Use of 1,3-D in California is currently limited to 47,500 lbs of active ingredient (approximately 5,000 gallons of Telone II) per township per year due to concern with air quality impacts. A second use limitation for 1,3-D is the 300 foot buffer zone required from any occupied residence. Most strawberry fields are located in heavily populated areas and growers using 1,3-D are subject to these restrictions. Because of these limitations, growers do not typically apply 1,3-D to strawberry fields.

Dow AgroSciences has recently developed an emulsifiable concentrate formulation, Telone C35 EC, that can be applied through a closed system sub-surface drip irrigation system into fields. Telone C35 EC is not currently registered in California, but results of research conducted by the University of California to test the efficacy of the product when delivered via closed system irrigation have been promising. Closed-system delivery via sub-surface drip irrigation reduces potential air contamination, exposure to workers and to the public, and may result in reduced rate applications. This type of delivery system could address the 1,3-D use limitations that currently discourage growers from using this effective tool.

Reduced Risk Pesticide Use in Conjuction With Certain Cultural Practices. Certain cultural practices, when applied in conjunction with chemical treatments can result in reduced chemical application rates, reduced air emissions and reduced exposure potential to workers, the public and the environment. Research is still needed to determine the efficacy of Telone C35 EC when applied at full and reduced rates via a closed system drip irrigation system. Data is also needed to determine if the use of certain cultural practices, such as the use of high barrier film, crop rotation, organic supplements or supplemental solarization will sustain the product's efficacy at reduced application rates.

VI. INNOVATIONS COMPARED TO EXISTING PEST MANAGEMENT SYSTEMS:

The current pest management system utilized by the strawberry industry includes cultural practices, biological controls and chemical treatment. A key existing component of the industry"s pest management systems is pre-plant fumigation with methyl bromide/chloropicrin. This combination is used to control soil-borne diseases, nematodes, arthropods that are present in the soil, and prevent weed germination of many important weed species. Since methyl bromide will no longer be available to strawberry growers after 2001, the industry must look at new, innovative approaches to replace this important chemical tool.

For many years, the California strawberry industry has had economic success in great part because of the broad-spectrum efficacy of the pre-plant fumigant, methyl bromide. Innovative techniques are being considered as long term fundamental components of a systems approach for pest control for the strawberry industry. These practices may result in reduced pesticide application rates and possibly fewer needed applications. Research in these areas is innovative because these

methods of pest control are just now emerging as potential tools for the industry. These innovative and potential tools are described briefly as follows:

- O Sub-Surface Drip Irrigation Systems. Significant reduction of potential exposures and furnigant releases resulting from direct injection of pesticides can potential be achieved through the use of sub-surface drip irrigation systems. Drip irrigation lines are placed under the surface of the soil where applications of water soluble products are applied directly into the soil. The soil helps trap the chemical material allowing for less emission and therefore risk, and prolonged soil contact and therefore increased efficacy of the product.
- O High-Barrier Films. These high barrier films entrap the soil-applied product until it degrades, thereby reducing the emission from the chemical or fumigant, and allowing for reduced application rates since the material is held longer in the soil.
- O Chemical and Organic Barriers. These chemical or organic barriers are supplements to plastic barriers and may be the pragmatic means to significantly reducing the potential risks of soil applied products.
- Soil Conditions. Experimentation is underway to identify the optimal soil conditions for reducing emissions and other potential hazards associated with treatments of soil-borne pests.

VII. POTENTIAL BARRIERS TO PROPOSED REDUCED-RISK METHODS:

The California strawberry industry must find viable alternatives, whether chemical or cultural, to the use of methyl bromide or it will face devastating economic impact. Potential barriers to the proposed reduced-risk methods include time, and funding.

The California strawberry industry must develop a viable pest management program that will replace the use of methyl bromide by 2001. Without a viable pest management program, the industry will face significant economic losses. Because there is little time, the industry must focus on the most promising short term solutions to fill the gap that will be left when methyl bromide is

no longer a pest management tool available to the industry. The most promising short term solutions are those that have been presented in the Pest Management Work Plan and have been discussed in this document.

The Pest Management Work Plan proposes a multi-faceted systems approach including research on sub-surface drip irrigation, solarization, high barrier films, crop rotation, and organic amendments/mulching. Experts experienced in each of these areas will be conducting the proposed research if funding is available. To date, matching funds have been committed to this research by the USDA, the California Integrated Waste Management Board, the University of California and the California Strawberry Commission. The PMA funding would allow for research to be expanded (sub-surface drip irrigation and solarization), while projects identified for future funding (organic mulching and high barrier films) could be done this year. Results of these studies and efficacy of the trials, would of course dictate implementation strategies.

VIII. CONCLUSIONS:

The strawberry industry has relied upon methyl bromide as a key tool in its pest management program. By the year 2001, the industry must develop an effective and viable program that will allow California growers to continue leading the nation in strawberry production. To be successful, this program will need to encompass all aspects of pest management, including cultural and chemical practices. New reduced-risk practices, such as soil solarization, crop rotation and reduced rate application methods, will be key components to a successful pest management system. Innovative research related to the treatment of soil-borne pathogens is critical to the continued success of the strawberry industry.

IX. REFERENCES:

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Management for Strawberries. 1994. University of California.

Statewide Integrated Pest Management Project, University of California. UC Pest Management Guidelines. University of California (http://www.ipm.ucdavis.edu).

X. APPENDICES:

- 1. California Strawberry Commission Pest Managment Evaluation Guideline.
- 2. Survey: Major Pests and Their Methods of Control in Strawberries in California.
- 3. UC Pest Management Guidelines Pest Diseases
- 4. UC Pest Management Guidelines Insects
- 5. UC Pest Management Guidelines Integrated Weed Management
- 6. UC Pest Management Guidelines Nematodes

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APPENDIX 1

CALIFORNIA STANWBERRY COMMISSION Post Management Evaluation Guide

Information in this table was compiled from the UC IPM Project cropinest, results of the Peat Management Survey Database developed by DPR, the UC IPM Project and Peat Control Advisors.

				enciborql	ester lade.l	Restricted Use Material.
		Drip or furrow intgation.	·%09	plus Captan 50 WP	sqi þ	\
Anthracnose		Clean plant stock.	Pest can reduce yield by	Велоту	QF 1	Preventative fungicide treatments.
Anguier Leaf Spot		Clean plant stock. Avoid overhead impation when possible	Pest reduces plant growth and fruit reducing yield by 10-20% during winter.	Fixed Coppers Methyl Bromidel chloropicnin	≈qi 001 -00 €	Repeated applications may be phytotoxic to plants. Preplant furnigation needed before next planting to being disease left in soil from previous infected plants.
DISEVSES						
. (A)	Biological Control	Cultural Control	Commentie	Snelbengril evitoA	Sena/kites	Comments
TSB9		NON-CHEMICAL TREATMEN	π		CHEMICAL	THEATHENT
		en i ditt in ennen feemaal sandalam :		refer a m at oo day 's tag fa nedere	MANAGEMENT AND LONG MANAGEMENT	.,

PEST		NON-CHEMICAL TREATME	NT .		CHEMICAL	TREATMENT
	Biological Control	Guitural Control	Comments	Active Ingredient	Rate/Acre ²	Comments
Botrytis Fruit Rot		Remove and destroy dead leaves and infected fruit. Plastic mulches prevent berry-soil contact.		Anilazine Benomyl plus Captan 50 WP Vinclozolin Iprodione (Rovral) Captan 50 WP Thiram Thiophanate-Methyl	Label rates 1 lb 4 lbs 1.5 lbs 1.5 lbs 4 lbs Label rates 0.75-1.0 lb	REI: 4 days. Potential resistance problems. Benomyl is rarely recommended by PCAs. Max use 4 times per season. Variable efficacy. Max use 4 times per season. Commonly recommended by PCAs. REI: 4 days. Commonly recommended by PCAs. Commonly recommended by PCAs. Tank mix with fungicide of different chemistry (Captan, thiram) to reduce resistance problems Resistance: To benomyl, iprodione, and vinclozolin. Alternate materials with different products.
Common Leaf Spot (significant economic impact)		Use resistant cultivars, and clean stock. Remove infected leaves. Drip irrigation.		Methyl Bromide/ Chloropicrin Chlorthalonil Benornyl	300-400 lb 2.0-2.75 pt Label rates	Pre-plant furnigation needed to kill overwintering disease. For Nursery Use Only (non-bearing strawberries).
				Copper hydroxide	Label rates	Variable effectiveness.

PES:	, iliz	NON-CHEMICAL TREATME	NT general ja salaga seligijas		CHEMICAL	TREATMENT'
4 4 5 <u>1</u>	Biological Control	Cultural Control	Comments	Active ingredient	Rate/Acre ²	Comments
Leather Rot		Avoid infested fields.		Methyl Bromide/ Chloropicrin	300-400 lbs	Preplant fumigation.
		Remove diseased fruit.	Additional research needed.	Metalaxyl (Ridomil 2E)	Label rates	Do not use more than 6 qts/acre/year. Cost is prohibitive.
		Plastic mulches.	Additional research needed.	·		providing.
		Orip irrigation.		l		
Mucor Fruit Rot		Remove plant debris.		Iprodione	, 1.5 lb	
		Remove all ripe fruit.		Vinclozolin	1.5 lb	
		Practice good sanitation during harvest, packing, transport and storage.		Captan 50 WP	1-4 <i>l</i> b	REI: 4 days.
Phythophthora Root and Crown Rot		Raised beds.		Methyl Brornide/ Chloropicrin	300-400 lbs	Preplant furnigant.
		Drip irrigation.		i i	l <u>.</u> .	
		Use resistant cultivars and clean stock.		Metalaxyl	Label Rates	Variable efficacy. Limited to 3 applications/ /crop/year.
		Plant in noninfested fields with good drainage.				
Powdery Mildew		Avoid overhead irrigation.		Sulfur	2.5 - 5.0 lbs	Application during high temperatures may burn foliage. Requires multiple treatments.
1		Use resistant cultivars.				
		Use clean stock.		Myclobutanii (Ratiy 40W)	2.5 - 5.0 lbs	PHI: 3 days. Apply in min. of 50 gal/acre. Sec. 18. Requires multiple treatments.
				Insecticidal Soap	2.5 oz/gal	PHI: 0 days. Not for use on new transplants, unrooted cuttings, or water-stressed plants.

Red Stele Red Stele Biological Control Use resista Clean stock Raised bed Drip irrigatic Keep soil pl Remove pla Use resistar Orip irrigatic			CHEMICAL TREATMENT	TREATMENT
Rot Respond Control Use Clear Chose Chose Control Chose				
gg.	Cultimal Control Comments	Active ingredient	Reta/Acre?	Comments
æ.	Use resistant cultivars and clean stock.	Methyl Bromide/ Chloropicnin	300-400 lb.	黄萝
Pot	Raised bads.	Metalaxyi	Label Rates	Variable efficacy. Limited to 3 applications/
Rot	Drip impation.			/crop/year.
ZG.	Keep soil pH at 7 or more.			
	Field sanitation. Only known control which	which		Typically does not cause excessive damage.
	Remove plant debris.			Fungicide treatment is generally not recommended.
	Use resistant cutitivars (those with thick cuticles).			
Use re clean	Avoid infested fields.	Methyl Bromide/	300-400 lb	Preplant furnigant. Kills beneficials and other
clean Drip ir	Use resistant cultivars and	Chloropicrin		non-target organisms.
Drip ir.	itock.	Methyl isothlocyanate	Label Rates	Preplant soil drench. Variable efficacy.
	Orio imigation.	Metam Sodium	Label Rates	Varibale efficacy.
Crop i	Crop rotation with nonsusceptible crop.			
Avoid high	Avoid high nitrogen fortilizers.			
Other, Unknown Eliology				

E.		NON-CHEMICAL TREATME				CUELLO A TOP A TABLETT
	Biological Control	Cultural Control			à	
INSECTS AND MITES						CAMINETIN
Aphids: Strawberry Aphid Meion Aphid	Proceedings: Symptonic, or green lacewing larvae.	Row covers, plastic tunnels or Remay-type enclosures.	Random sampling. Treat chemically if infestation level reaches 30%.	Diazinon	-	PHI: 5 days. Apply in 100 gal waterfacre. May injure mite predators. Should be used with other control lactivs. Not the treatment of
Potato Aphid		Control dust to facilitate parasite and predator activity.	Natural predators are useful, but offen appears too late in season.	Insecticidal Soap	2.5 cz/gal	choice. Apply in 100 gal water/acre. Possibly phytotoxic. Discolors fruit on repeat applications. Will kill approx. 50% of beneficial predatory mite eggs. Rarely used.
				Azadirachtin	Label rates	Additional research needed.
				Malathion	Lowest label rate	Most common treatment, but requires multiple applications.
				Naied	Label rates	Kills beneficial and non-target organisms. Rarely recommended by PCAs.
Beet Armyworm	Natural parasita: Hyposoter eqigua	Weed control.	Monitor natural parasite population to determine if armyworms will be controlled to nearest	Bacillus Thuringlensis (Javelin) WG (Dipel) 2X	1-1.25 lb 0.5-2 lb	Variable Efficacy. Requires multiple treatments. PHI: 0 days PHI: 0 days.
			enemies. More research needed.	Chlorpyrifos	Label rates	Kills beneficials and non-target organisms.
			Elimination of weed hosts	Diazinon	Label rates	
			should be used in conjunction with another	Endosulfan	Label rates	
			tactic.	Methomyl	Labei rates	Kills beneficials and non-target organisms. May be used as last resort at end of season.

PES		NON-CHEMICAL TREATMEN	,			
					CHEMICAL	CHEMICAL TREATMENT
	Biological Control	Cultural Control	Comments	Active ingredient	Rate/Acre	S Comments
Cabbage Looper	Parastic wasps: Hyposoter exiguae; Copi-dosoma truncatellum; Trichogramma Disease: Nuclear polyhedrosis virus	Do not plant next to lettuce fields.	Additional research needed on biological control. Effectiveness dependent upon chemical treatment program.	Baciflus Thuringiensis (Dipel) 2X (Javelin) WG Chlorpyrifos	0.5-1 lb 0.25-0.5 lb Label rates	Use when loopers are in 1st or 2nd instar Kills beneficials and non-target organisms.
Com Earworm	Parastitic wasps: Trichogramma pretioeum Predator: Minute pirate Bug	Plant early maturing sweet com cuttiver around fields.	Biccontrol agents provide some suppression; however, the very low tolerance for insect contamination makes this control less effective. Sweet com diversion planting should be used in conjunction with another tactic.	Methomyl Lannate LV Lannate Chlorpyrifos Bacillus Thuringiensis	2-3 pts 1 tb Label rates Label rates	Kills beneficials and non-target organisms. PHI: 3 days (fresh) PHI: 10 days (processing Kills beneficials and non-target organisms. Recommended by PCAs.
Cutteroms		Weed control. Avoid 2nd year plantings.		Bacillus Thuringiensis (Dipel) 2x (Javelin) WG Carbaryl (Sevin 5% Balt) Chloropicrin Diazinon	0.5-1 tb 0.5-1 tb 40 tbs Label rates Label rates	Variable efficacy. Requires multiple applications. PHI: 1 day. Effective. Effective. Used after planting at low cost. Kills beneficial and non-target organisms. Worker safety issues.

PES.		NON-CHEMICAL TREATME	NT		CHEMICAL	TREATMENT
<u> </u>	Biological Control	Cultural Control	Comments	Active Ingredient	Rate/Acre ¹	Comments
Cyclamen Mite	Predator Mites: Typhlodromus bellinus T. reticulatus	Clean stock.	Use in conjunction with another treatment.	Avermectin	Label rates	More expensive. Temperature/sesson dependent.
	Natural enemy: Sixspotted thrips	Pre-plant hot water bath for infested stock.	Variable effectiveness.	Dicofol (Kelthane) 35 WP	Label rates	PHI: 2 days. Variable effectiveness. Potential
		Avoid 2nd year plantings in problem areas.	More expensive. Must be used in conjunction with another treatment.	Endosulfan (Thiodan) 3EC	Label rates	PHI: 4 days. Variable effectiveness. Potential
	-	Destroy rubbish near field.		Propargite	Label rates	groundwater contamination. Potential phytotoxicity
European Earwig		Destroy rubbish near field.	Expensive.	Carbaryl (Sevin 5% bait)	40 tbs	
Fruit Fly		Completely remove ripe ~ fruit from plants.		Pyrethrin (Py-rin)	4-20 oz	
		Shorten harvest intervals when temperatures increase.		Pyrethrin plus Piperonyl Butoxide (Py-rin 60-6) EC	2-16 oz	
		Good sanitation in and around field.				
٠		Remove cull piles and other nearby rotting fruit.				
Garden Symphylan		Continuous flooding for 3 weeks in summer.	Additional research is needed.			
		Discing in sorghum.	Additional research is needed.			

PES.		NON-CHEMICAL TREATME	NT 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		CHEMICAL	TREATMENT!
	Biological Control	Cultural Control	Comments	Active Ingredient	Rate/Acre ²	Comments
Garden Tortrix		Remove accumulated trash in Spring.	Significant labor needed.	Bacillus Thuringiensis (Dipel) 2X	0.5-1 t b	PHI: 0 days.
		Sort out contaminated berries.	Significant labor needed.			
		Avoid 2nd year plantings.	Expensive.			İ
Lygus Bugs	Predators: Bigeyed bugs Damsel bugs Minute pirate bugs	Weed control along roadways, ditches and field borders.	Variable efficacy. Must be used in conjunction with another tactic.	Naled (Dibron) 8 EC	1 pt.	PHI: 1 day. Kills beneficial and non-target organisms. Ineffective on certain species.
	spiders	Mow or disc under cover crop when lygus are still in nymphal stages.		5EC 25WP	1.5-3 pts 6 tbs	PHI: 3 days. Variable effectiveness. Requires multiple treatments. Short or no residual.
:	<u>:</u>	Bug vacuums.	Vacuuming may increase problems with powdery mildew and gray mold.	Methomyl Lannate Lannate LV	1 tb 3 pt	PHI: 3 days (fresh), 10 days (processing. Variable effectiveness. Requires multiple treatments. Kills beneficials and non-target organisms.
				Insecticidal Scap M-Pede	2.5 oz/gał water	organisms.
				Diazinon	Label rates	Requires multiple treatments. Variable effectiveness. Must be used in conjunction with another tactic.
1				Methyl Bromide	Label rates	
				Petroleum Distillates, aromatic	Label rates	Variable effectiveness.
			,	Pyrethrins	Label rates	Variable effectiveness. More expensive. Lower yield, lower grade.

PES		NON-CHEMICAL TREATMEN			CHEMICAL TREATMENT	REATHENT
	Biological Control	Cultural Control	Comments	Active Ingradient	Rate/Acret	Сопината
Western Flower Thrips	Predator: Minute pirate bugs		Minute pirate bugs feed on thirps, but things feed on twospotted spider and cylamen miles.			
			Control is not usually necessary because this pest rarely causes economic damage.			
Whitefles			Pest is an increasing problem. Impacts market quality and yield.	Potash Soap	Label rates	Variable efficacy. Problems with phytotoxicity.
NEMATODES						
Nematodes - lesion, stem, dagger,		Tolerant cultivars and certified nursery stock.	Cultural practices can be expensive and time	Methyl Bramide/ Chloropicnin	300-400 lbs	Preplant control. Very effective.
root knot		Field soil sample analysis.	require pre-planning.	Metam Sodium	Label rates	Preplant applications. Variable, but satisfactory control with proper application techniques.
		Pre-plant hot water treatments for stock.		Oxamyi	Label rate	Only registered for use on root knot and lesion
		Clean equipment to				be phytotoxic to some cultivars.
		nematodes.		Chloropicrin	Label rates	More research needed for efficacy.
		Crop rotation following fallow.				

1 SHA	•	MON CUETACAL TOTAL				
		WON-CHECKL INEA I ME	- 2		CHEMICAL TREATMENT	TREATMENT
	Biological Control	Cultimat Control	Comments	Active ingradient	Rate/Acre?	Comments
Western Flower Thrips	Predator: Minute pirate bugs		Minute pirate bugs feed on thrips, but thrips feed on twospotted spider and cytemen mites.			
			Control is not usually necessary because this pest rarely causes economic damage.			
Whiteflies			Pest is an increasing problem. Impacts market quality and yield.	Potash Soap	Label rates	Variable efficacy. Problems with phytotoxicity.
NEMATODES						
Nematodes - lesion, stem, dagger, needle, foliar, and		Tolerant cultivars and certified nursery stock	Cultural practices can be expensive and time	Methyl Bromide/ Chloropicrin	300-400 lbs	Preplant control. Very effective.
root knot	_	Field soil sample analysis.	require pre-planning.	Metam Sodium	Label rates	Preplant applications. Variable, but satisfactory
		Pre-plant hot water treatments for stock.		Oxamyl	Label rate	control with proper application techniques. Only registered for use on root knot and lesion
		Clean equipment to prevent transfer of				nematodes on nonbearing nursery stock. May be phytotoxic to some cultivars.
		nematodes.		Chloropiczin	Label rates	More research needed for efficacy.
		Crop rotation following fallow.		-		

PEST		NON-CHEMICAL TREATMEN	TN			TOTAL A TANKENT
	Ripionical Control					CHEMICAL INCA INCA I
WEEDS			Convents	Active ingredient	Rete/Acre	Comments
Weeds, such as:		Onerge pleatic matches				
Barloy		charles basens illassessa.	•	Methyl Browide	300 330	
Bluegrass Bluegrass		Organic mulches: wood shawings, chooped straw		Chloropicrin	100-150 lbs	Appear to pre-ingated soil. Must be tarped. Very effective.
Burning nettle		rice hults.		<u> </u>		Applied to pre-impaled soil
Common groundset		Solarization.	Need additional research.	Metam Sodium	238-318 lbs	
Little mallow				DCPA Decthal W-75	9	
				Propert: Post.		
				Paraquet Gramocone Extra	0.515	
				Postplant - premerce of Weed:		
				DCPA Dectral W-75	200	
				Napropamide Devrinol	2-4 lbs	May inhibit strawberry rumers.
				Postplant. post- emargance of weed Sethyoxydim	0.38-0.47 lb	PHI: 7 days. Only 1 application per season
						allowed. Control varies with species.

OMMALDescratures 14-98

1. Based on information from UCD IPM Program. This guide is not intended as a recommendation for use. See California-registered product labels for specific label rates and use

2.Rates/200 gallons water/acre unless noted otherwise.

APPENDIX 2

This table lists chemic of non-chemical control methods for the major pests on strawbernes in California. Explanations of the following table. Data is from the 1998 Pest Management Survey Database, which by DPR and the UC! le IPM Project. Department of Pesticide Regulation—April 15, 1998

Dy D-K - B - M - FO	läng nahanmuar	ć ca Lasocina Leišmanou→ Vhra 12' 1860	•	·		•		٠	•_		l .			1
Pest	Seed to me	Al or Control Method	-	Ret	explanation for	4 a - au . au		2nd	_				y	
real	Peat type	BACILLUS THURINGIENSIS (BERLINER).	Region	ing	rating of 3	Limitations	APP	App	Stet	standerds	red.	94	C	Marine Marine
ALFALFA LOOPER	INSECTS	SUBSP. KURSTAKI, SEROTYPE 3A,38 BACILLUS THURINGIENSIS (BERLINER).	COASTAL	2		LESS/VARIABLE EFFECTIVENESS	G		7	SOMETIMES	10	3	19	
ALFALFA LOOPER	INSECTS	SUBSP. KURSTAKI, SEROTYPE 3A,38	COASTAL	2			G		H	ALWAYS	(D	1	
ALFALFA LOOPER	INSECTS	BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, SEROTYPE 3A,38 BACILLUS THURINGIENSIS (BERLINER).	. S COAST	2		•	G		N	ALWAYS	(D	1	•
ALFALFA LOOPER	INSECTS	SUBSP. KURSTAKI, SEROTYPE 3A.38	SAN JQ	2			_							•
ANGULAR LEAF SPOT		Total . Home . And a Cate 111 E and and	OF 11 DE	-			G		N	ALWAYS	C	3	1	
(XANTHOMONAS FRAGARIAE)	PATHOGEN	AVOID OVERHEAD IRRIGATION.	COASTAL	0		ADDITIONAL RESEARCH IS NEEDED				RARE	10		10	
ANGULAR LEAF SPOT (XANTHOMONAS FRAGARIAE) ANGULAR LEAF SPOT	PATHOGEN	CLEAN PLANTING STOCK	COASTAL	2		ADDITIONAL RESEARCH IS NEEDED				RARE	10	3		
(XANTHOMONAS FRAGARIAE) ANGULAR LEAF SPOT	PATHOGEN	VINCLOZOLIN	COASTAL	0			g	A	H	ALWAYS	•	,	4	
(VANTHOMONAS FRAGARIAE) ANGLIAR LEAF SPOT	PATHOGEN	VINCLOZOLIN	COASTAL	0								3	0	
(XANTHOMONAS FRAGARIAE) ANTHRACHOSE (COLLETOTRICHUM	PATHOGEN	VINCLOZOLIN	S COAST	0			G	A	N	ALWAYS	0	,	4	
ACUTATUM) ANTHRACHOSE (COLLETOTRICHUM	PATHOGEN	BENOMYL.	COASTAL	2			G		H	ALWAYS		•	4	
ACUTATUM) ANTHRACHOSE (COLLETOTRICHUM	PATHOGEN	BENOMM.	S COAST	2			G		N	ALWAYS		,	4	
ACUTATUMO ANTHRACHOSE (COLLETOTRICHUM	PATHOGEN	CLEAN PLANTING STOCK	COASTAL	2		ADDITIONAL RESEARCH IS NEEDED				SOMETIMES	20) 3		
ACUTATUMO ANTHRACHOSE (COLLETOTRICHUM		DRIP OR FURROW IRRIGATION.	COASTAL	0								3	0	
ACUTATUMO ANTHRACNOSE (COLLETOTRICHUM		PRODIONE	COASTAL	2		RESTRICTED USE MATERIAL	G	A	N	ALWAYS	٥	,	4	
ACUTATUM	PATHOGEN	IPRODIONE	SCOAST	2	•	RESTRICTED USE MATERIAL	G	A	N	ALMAYS	0	,		
APHIOS	INSECTS	AZADIRACHTIN	COASTAL	4		ADDITIONAL RESEARCH IS NEEDED	Ğ	••			7 ັ	· · ·	7	
APHIOS	INSECTS	AZADIRACHTIN	\$ COAST	4		ADDITIONAL RESEARCH IS NEEDED	Ğ				,		÷	
APHIOS	INSECTS	AZADIRACHTIN	OL MAR	4		ADDITIONAL RESEARCH IS NEEDED	Ğ				;		4	
APHIOS .	INSECTS	DIAZINON	COASTAL	_		MUST BE USED IN CONJUNCTION WITH ANOTHER SUBSTANCE OR TACTIC	G	A		FREQUENTLY	•	5	1	
APHIOS	INSECTS	DIAZINON	COASTAL	3.	IT PROVIDES A SHORT WORKER RE-ENTRY INTERVAL	ADDITIONAL RESEARCH IS NEEDED	Œ		7	FREQUENTLY	•	5 3		
APHIDS	INSECTS	DIAZINON	COASTAL		IT PROVIDES A SHORT WORKER RE-ENTRY INTERVAL	PARTICULAR SPECIES	G		7	PREQUENTLY	ŧ	5 3	10	
APHIDS	INSECTS	DIAZINON	S COAST	2		MUST BE USED IN CONJUNCTION WITH ANOTHER SUBSTANCE OR TACTIC	G	A	?	FREQUENTLY	;	5	1	
APHIOS	INSECTS	DIAZINON	SAN JQ	2		MUST BE USED IN CONJUNCTION WITH ANOTHER SUBSTANCE OR TACTIC REQUIRES MULTIPLE TREATMENTS OR	G	A	7	PREQUENTLY	•	5	1	
APHIOS APHIOS	INSECTS INSECTS	MALATHION MALATHION	COASTAL			APPLICATIONS SHORT OR NO RESIDUAL	G		Y	FREQUENTLY	10	-	1	
APHIOS	INSECTS	MALATHION	S COAST	2		REQUIRES MULTIPLE TREATMENTS OR APPLICATIONS	G		Y	FREQUENTLY	10	_	1	
APHIOS	INSECTS	MALATHION	S COAST	2		SHORT OR NO RESIDUAL REQUIRES MULTIPLE TREATMENTS OR	Ģ			FREQUENTLY	10		1	,
APHIOS	INSECTS	MALATHION	SAN JQ	2		APPLICATIONS	G		Y	FREQUENTLY	10	a •	1	
APHIOS	INSECTS	MALATHION	DL NAZ	2		SHORT OR NO RESIDUAL KILLS BENEFICIAL AND/OR NONTARGET	Ğ		Ÿ	FREQUENTLY	10		i	
APHIDS	INSECTS	NALED	COASTAL	. 2		ORGANISMS KILLS BENEFICIAL AND/OR NONTARGET	S		N	FREQUENTLY	10)	1	
APHIOS	INSECTS	NALED	S COAST	2		ORGANISMS KILLS BENEFICIAL AND/OR NONTARGET	G		N	PREQUENTLY	10	D	1	
APHIOS ,	INSECTS PLANT	NALED	SAN JQ	2		ORGANISMS	G		H	FRECUENTLY	10	3	1	
BARLEY	(WEEDS) PLANT	OPAQUE PLASTIC MULCHES	COASTAL	3	NOT APPLICABLE							3	39	
BARNYARDGRASS	(WEEDS)	OPAQUE PLASTIC MULCHES BACILLUS THURINGIENSIS (BERLINER),	COASTAL	3	NOT APPLICABLE							3	19	
BEET ARMYWORM	INSECTS	SUBSP. KURSTAKI, SEROTYPE 3A,3B BACILLUS THURINGIENSIS (BERLINER),	COASTAL			LESS/VARIABLE EFFECTIVENESS	G		?	SOMETIMES	10	2 3	IĢ	
BEET ARMYWORM	MSECTS	SUBSP. KURSTAKI, SEROTYPE 3A,38 BACILLUS THURINGIENSIS (BERLINER),	COASTAL			LESSIVARIABLE EFFECTIVENESS REQUIRES MULTIPLE TREATMENTS OR	G		N	FREQUENTLY	\$	5	1	
BEET ARMYWORM	INSECTS	SUBSP. KURSTAKI, SEROTYPE 3A,38	COASTAL	. 2		APPLICATIONS	G		N	FREQUENTLY	5	•	1	

Major peats and non-chemical control methods for the major peats and their methods of control in strawberries in California. From the following table. Data is from the 1996 Peat Menagement Survey Database, whit.

by DPR and the UC ** ride IPM Project. Department of Peatscide Regulation- April 15, 1998.

	:		FREDUENTY				WOKE EXPENSIVE		2	S COAST	YAORD RECOND LEVY BIVALING	IMZEC18	BLACK VINE WEEVIL
		L	FREQUENTLY				ANOTHER SUBSTANCE OR TACTIC		3	COVELVE	VACID SECOND LEVIS STVILLING	SLOBSNI	BLACK VINE WEEVIL
							MUST BE USED IN CONJUNCTION WITH					0.20.001	
	l.	Ł	FREQUENTLY				WORE EXPENSIVE		Z	COYSTAL	VACID RECOND LEVY INTVILLING	INSECUS	BEYOK AIME ANGEAIL
	•	0	YFMYKS	N		ອ			ī	TSAOOR	WEITHAL BROWIDE		
						_	KILLS BENEFICIAL AND/OR NONTARGET		•	124002	POINTOG WHEN	NECORTAG (MUN)	BLACK ROOT ROT (PYTH
	•		VEWAYS	N		j	TOOLTHOU GOODLE INTIGATIONS OF IN	107 1 101 11 11 11 11 11 11					_
	•		OA44117	14		29		TREST TRIMADA BUOIDAS		SCOAST	METHYL BROWIDE	MBOOHTA9 (ML)	BLACK ROOT ROT (PYTH
	_	_						NOWN CONTROL WHICH	ONITA KB				
	•	0	SYAWJA	N		Ð	OKCYMZINZ.		•	JATZAGO	METHYL BROMIDE	IUM) PATHOGEN	ВЕАСК ROOT ROT (РУТН
							ICIT'S BEMELICIYY YNDION NONLYBEEL		•			AGOSTAG ANN	HIND TOO TOO NO 19
	*		SAVMTV	N		£		TS34 TSMIADA EUOLOAS	713 CL C	~!!~	Tallends of marianes		
				*-		_				COASTAL	WELLIAL BROWIDE	NECHTA9 (NU)	BLACK ROOT ROT (PYTH
		0	SAYMTY			_		NOWN CONTROL WHICH					
		_			Y	Ð	RESTRICTED USE MATERIAL		ζ	S COAST	IPRODIONE	NEGOHTAS (MU)	BLACK ROOT ROT (PYTH
	•	0	SYAWJA		٧	ອ	RESTRICTED USE MATERIAL	•	2	COASTAL	INCIDIONE		BLACK ROOT ROT (PYTH
	•	0	Skawia	N		3			•	12AOO 2	CHLOROPICIRIN		BLACK ROOT ROT (PYTH
	•	Ð	SAYMTY	N		£				COASTAL			
	ı	\$	SAYMTY	Ł		ก	ORGANISMS		ź		CHLOROPICRIN		BLACK ROOT ROT (PYTH
	•	_		_		•	OBSTRUCTORY AND OR NONTARGET		6	DL HAZ	METHOMYL	STOBSM	BEET ARMYWORM
	ı	·e	HREQUEAULY			_							
	٠	*	V MUCH INCHES	Ł		Ð	ORGANISMS		Z	SCOAST	METHOMYL	SIJJESNI	BEEL VUINAOUN
							ICLLS BENEFICIAL ANDIOR NONTARGET						
	Œ	Ş	SOMETIMES			ອ	APPLICATIONS		Z	COVELVE	METHOWN	SLOBSM	#0.00 to 1.00 m/ 1.00 m
							REQUIRES INULTIPLE TREATMENTS OR		•		MACHTEAL	amasua	BEET ARMYNORM
	ı	c	SAVMTV	1		Ð			_				
	•	•	DATA()	•			ORGANISMS		5	COASTAL	METHOMYZ	MZECLZ	BEET ARMYWORM
		_					KILLS BENEFICIAL AND/OR NONTARGET						
	ŀ	S	SOMETHMES				<i>TERRANDITE ELLECLIAENERR</i>		ı	DC NVS	HYPOSOTER EXIGUA AND A VIRUS.	MZECLZ	BEET ARMYWORM
	į.	ç	SOMETIMES				CHEMICAL SPRAY PROGRAM		Ĺ	OL NAS	HAPOSOTER EXIGUA AND A VIRUS.	SICIS	
							ELLECTIVEMESS DEPENDS ON		,	Or 1449	HYDOCOTED EXICILA AND A MOUR	PUSSM	MACAWAMA 1338
	Į.	Oī	SOMETIMES				TESSAVISIVE ELLECTIVENESS						
	Ĺ	οι	SOMETIMOS						ŀ	S COAST	HYPOSOTER EXIGUA AND A VIRUS.	SLOBSM	MROWYNAN T338
	•	ν.	STATEMENT				CHEMICAL SPRAY PROGRAM		ì	S COAST	HYPOSOTER EXIGUA AND A VIRUS.	SLOBSM	BEET ARMYWORM
	_						EFFECTIVENESS DEPENDS ON						
		ş	SOMETIMES				TERZANDINENE ELLECTIVENESS		t.	COVELVE	HYPOSOTER EXIGUA AND A VIRUS.	MRECLIS	Market Links (1770)
	ı	5	SOMETIMES				CHEMICAL SPRAYY PROGRAM		i	COVELVE	HYPOSOTER EXIGUA AND A VIRUS.		REET ARMYNORM
							ELLECTIVE MESS DEPENDS ON		•	.125100	HAROSOTER EXICALA AND A VIDICE	MSECTS	BEET ARMYWORM
	æ	OL	MENES				YDDILLOWYF ISESEVICH IS NEEDED						
	ī						GOCCOSA DI LOGA 2928 LAMORTICITÀ		SIBHITO 0	COVELVE	HYPOSOTER EXIGUA AND A VIRUS.	MZECLZ	BEET ARMYNORM
	;								7	OL NA2	EMDOSOIT: VM	SLOSSNI	BEET ARMYWORM
	•								•	TZA00 2	ENDOSONEVA	SLOSSNA	BEEL VISILAMOISM
	3								•	TVLSVOO	ENDOSOLEAN	MAECIA	BEET ARMYNORM
	6 C.								Ô	COVALVE	ENDOSOFEVA		
	ŀ	S	FREQUENTLY				ANOTHER SUBSTANCE OR TACTIC		ŏ	DENVS		MSECTS	BEET ARMYNORM
							MUST BE USED IN CONJUNCTION WITH		v	O MAS	ELIMINATE WEED HOSTS.	MSECLIS	BEET ARMYNORM
	ı	ç	FREQUENILY						_				•
	i	ŝ	FREQUENTY				TOWER METOLOWER GRADE		0	DL NA2	ETWINVIE MEED HOOLG	SICES	BEEL VISIUMOISN
	-						SESSIVATE EFFECTIVENESS		0	or nys	ETHINNYIE MEED HORIZ	STOBSM	BEET ARAMORM
	ŀ	Of	SOMEJINES .				ANOTHER SUBSTANCE OR TACTIC		ι	TEACO 8	ETHINAVIE WEED HOSTS.	MAECIS	BEET ARAMYORM
							MICEL BE DRED IN CONTINUCTION WITH					940304	10010010111330
	ι	GF	SOMETIMES				CONER METATOMER GRYDE	•	1	SCOAST	- Address and a second		
	L	Of	SOMELIMES				TERRAYSIVE ELLECTIVENESS		*		ETIMINATE WEED HOSTS.	NSECTS	BEET ARMYNORM
	Ĺ	S	HEOLENTY						<u> •</u>	72 COAST	ELIMINATE WEED HOSTS.	MZECLIS	BEEL YENLANOISM
	•	•	V (P.C.) (C.)				ANOTHER SUBSTANCE OR TACTIC		2	COVELVE	ELIMINATE WEED HOSTS.	NASCLA	BEEL VISHANOKS
	_	_					MUST BE USED IN CONJUNCTION WITH						
	ľ	ş	Y TINEULDSHI				TOWER METOLOWER GRADE		Z	TATZACO	ETHINYLE MEED HOSLS	MRECLA	BEET ARAYMORM
	ŀ	5	FREQUENTLY				TERRAVISIVE ELLECTIVENESS		ž	COVELVE	ETHINNIE MEED HORIS	MEECLE	
	Œ	30	MEVER				VOOLUGHAY BEZEVISCH IS NEEDED		я≘нгоо	JATZACO			BEET ARMYNORM
	ı	c	FREQUENTLY	ઢ	٧	Ð	_ :				ELMMATE WEED HOSTS.	· SLOBSNI	BEET ARMYWORM
	i	Š	FREQUENTY	ĭ	Ÿ	Ð			2	DL NAS	HONIZVIC	INSECTS	BEET ARITMORM
	i	ş							Z	S COAST	- NONEZYICI	MECLE	BEEL YERNAMOERN
	-		FREGUENTLY	4	٧	Ð			2	COASTAL	DIVSHON	STOBSM .	BEEL YUNUMOUN
	ŧ	r	SAVMTV	N		0	SHEWADRO		Z	OL MAS	CHLORPYMEOS	#IZEC13	BEET ANAMORM
							ICIT'S BENELICIVIT VNOVOK NONLYKGEL		_				11001110101 2230
	ı		SAYMTY	N		Ð	ORGANISMS		7	TZA0578	OO MIL DIRECTO		
						_	KILLS BENEFICIAL ANDIOR NONTARGET			19407.9	CHLORPYREOS	MSEC13	MACWYNSIA 1338
	ı	L	SAYMTY	44		Ð			_				
	•	•	Ov Asset 14	14		_	ORGANISMS		Z	JATZACO	CHTOENSHEOS	STOBSM	BEEL VISHLANCKSN
		_					HOLLS BENEFICIAL ANDIOR NONTARGET						
	ı	ç	YJINEUOSIEI	N		Ð	APPLICATIONS		2	DL NAR	SUBSP. KURSTAIQ, SEROTYPE 3A,38	SLOBSNI	BEET ARKWORM
•							REQUIRES MULTIPLE TREATMENTS OR		•		BYCHTICS LIHININGIENZIZ (BESTINES)"	91:1:3344	MONAMMA 7330
	ı	5	FREQUENTY	M		Ð	TERSAYMYBITE ELLECLIABINERS						
•	-	-				•	EEGATOITO E CECELUITETES		2	OL MAS	SUBSP. HURSTAND, SERIOTYPE 34,38	M2EC13	BEET ARMYWORM
		_	(7)			_					BACILLUS THURINGIENSIS (BERLINER),		•
	ı	S.	YMEUDER	N		Ð	VPPLICATIONS		Z	120002	SUBSP. IQURSTAND, SEROTYPE 3A,38	MSECLS	BEEL YUNUMOUN
							REQUIRES INULTIFIE TREATMENTS OR				BYCHTAS JHANNOIDIZE (DEISTMEN)"	= " *	
	\$	S	FREQUENTLY	N		Ð	TERRAYBIVE ELLECTIVENESS		7	12A00 2	SUBSP. KURSTAKI, SEROTYPE 3A,38	\$109SM	BEET ARMYNORM
			_			-			•		BACILLUS THURINGIENSIS (BERLINER),	A17/23/M	MONTH ABLANCIA
		-	SDRTUHE :	1026	ddy d	4	suchthal)	g jo Buger	6	uoiSey	Dominia in Control Method Fig. 111 St. 111 St	edit med	
		_											
	4								Guy	Recion	hadded better 14	and the	~
	Log				P42 . 3		· · · · · · · · · · · · · · · · · · ·	tot notisusigs.	inst in the second	Region	i of Pesticide Regulation - April 15, 1986		

This table lists chemical and non-chemical control methods for the major posts on strawberries in California. Explanations of I' write following table. Date is from the 1996 Pest Management Survey Detabase, which by DPR and the UC ' Ide IPM Project. Department of Pesticide Regulation—April 15, 1998

STOCKERS HE OC SERVICE	olier nebenne	if or seasoning tradingspourr Vbut 12' 1860			•							. 1
-	.			Ratplenation for		180	2nd	Re	Most market	Yield	Svy	•
Pen	Pest type	Al or Control Method	Region	ing rating of 3	Limitations MUST BE USED IN CONJUNCTION WITH		Арр			red.	_	Communic
BLACK VINE WEEVIL	INSECTS	AVOID SECOND YEAR PLANTING	S COAST	2	ANOTHER SUBSTANCE OR TACTIC				FREQUENTLY	-		
BLACK VINE WEEVIL	NSECTS	AVOID SECOND YEAR PLANTING	SAN JO	ī	MORE EXPENSIVE						1	
				•	MUST BE USED IN CONJUNCTION WITH				PRECIDENTLY	*	1	
BLACK VINE WEEVIL -	INSECTS	AVOID SECOND YEAR PLANTING	OL HAS	1	ANOTHER SUBSTANCE OR YACTIC				FREQUENTLY	7	t	
BLACK VINE WEEVIL	INSECTS	STICKY BARRIERS TO PREVENT MOVEMENT OF WEEVILS.	COASTAL	0	LEGGALADIADI E EFERTMANIA					_		•
		STICKY BARRIERS TO PREVENT	COMPINE	U	LESS/VARIABLE EFFECTIVENESS				CHARGEDIAN	7	1	•
BLACK VINE WEEVIL	INSECTS	MOVEMENT OF WEEVILS. STICKY BARRIERS TO PREVENT	COASTAL	O	MORE EXPENSIVE				UNICHONS	7	t	
BLACK VINE WEEVIL	INSECTS	MOVEMENT OF WEEVILS. STICKY BARRIERS TO PREVENT	COASTAL	0	PROBLEMS WITH AVAILABILITY				UNIQUOMN	7	1	
BLACK VINE WEEVIL	INSECTS	MOVEMENT OF WEEVILS. STICKY BARRIERS TO PREVENT	COASTAL	0	SIGNIFICANT LABOR REQUIRED				LANGICIANI	7	1	
BLACK VINE WEEVIL	INSECTS	MOVEMENT OF WEEVILS.	COASTAL	4 OTHER	MUST BE USED IN CONJUNCTION WITH ANOTHER SUBSTANCE OR TACTIC				ALWAYS	40	30	
BLACK VINE WEEVIL	NSECTS	STICKY BARRIERS TO PREVENT MOVEMENT OF WEEVILS.	S COAST	G	LESS/VARIABLE EFFECTIVENESS				UNIQUOME	7	1	
BLACK VINE WEEVIL	INSECTS	STICKY BARRIERS TO PREVENT MOVEMENT OF WEEVILS.		_						•	•	
		STICKY BARRIERS TO PREVENT	8 COAST	0	MORE EXPENSIVE					7	.1	
BLYCK AINE MEEAIT	INSECTS	MOVEMENT OF WEEVILS. STICKY BARRIERS TO PREVENT	S COAST	0	PROBLEMS WITH AVAILABILITY				UNICHONN	7	1	
BLACK VINE WEEVIL	INSECTS		-8 COAST		SIGNIFICANT LABOR REQUIRED				UNGGIOWIN	7	1	
BLACK VINE WEEVIL	NSECTS	MOVEMENT OF WEEVILS. STICKY BARRIERS TO PREVENT	SAN JQ	0	LESSIVARIABLE EFFECTIVENESS				CHRONOWN	7	1	
BLACK VINE WEEVIL	INSECTS	MOVEMENT OF WEEVILS. STICKY BARRIERS TO PREVENT	SAN JQ	o .	MORE EXPENSIVE				LENGHOWN	7	1	
BLACK VINE WEEVIL	NSECTS	MOVEMENT OF WEEVELS. STICKY BARRIERS TO PREVENT	SANJO	0	PROBLEMS WITH AVAILABILITY				LINGUICHINI	7	1	
BLACK VINE WEEVIL	MSECT8	MOVEMENT OF WEEVILS.	CL HAS	٥	SIGNIFICANT LABOR REQUIRED				LINEGICINEE	2	٠,	
	PLANT									•	•	
BLUEGRASS	(WEEDS)	OPAQUE PLASTIC MULCHES	COASTAL	3 NOT APPLICABLE							39	
BOTRYTIS FRUIT ROT (GRAY MOLD		ANILAZINE	COASTAL	0							39	
BOTRYTIS FRUIT ROT (GRAY MOLD		BENOMYL.	COASTAL	2	POTENTIAL RESISTANCE PROBLEMS	G	A	N	ALWAYS	8		
BOTRYTIS FRUIT ROT (GRAY MOLE) PATHOGEN	BENOMYL	S COAST	2	POTENTIAL RESISTANCE PROBLEMS	Ğ	Ä		ALWAYS	ō		
BOTRYTIS FRUIT ROT (GRAY MOLE	PATHOGEN	CAPTAN	COASTAL	IT PROVIDES A SHORT WORKER 2 RE-ENTRY INTERVAL		G			ALWAYS	٥		
	_				MUST BE USED IN CONJUNCTION WITH	_		•••		•	•	
BOTRYTIS FRUIT ROT (GRAY MOLD	PATHOGEN	CAPTAN	COASTAL	2 IT PROVIDES A SHORT WORKER	ANOTHER SUBSTANCE OR TACTIC	G		Y	SOMETIMES	10	39	
BOTRYTIS FRUIT ROT (GRAY MOLD	PATHOGEN		S COAST	2 RE-ENTRY INTERVAL	•	G		N	ALWAYS	0	4	
BOTRYTIS FRUIT ROT (GRAY MOLE	PATHOGEN	REMOVAL & DESTRUCTION OF DEAD OR INFECTED PLANT MATERIAL.	COASTAL	2	ADDITIONAL RESEARCH IS NEEDED				SOMETIMES	20	39	
CONTRACTOR CONTRACT AND AVENUE OF THE	BATHACON .	USE PLASTIC MULCHES TO PREVENT			-					ه م		
BOTRYTIS FRUIT ROT (GRAY MOLE BOTRYTIS FRUIT ROT (GRAY MOLE		BERRY-SOIL CONTACT. VINCEOZOLIN	COASTAL	2	ADDITIONAL RESEARCH IS NEEDED				SOMETIMES	20	39	
BOTRYTIS FRUIT ROT (GRAY MOLE			COASTAL	2		G	A	N	ALWAYS	0	- 4	
BUINTING HON HOLL	PLANT	VINCLOZOLIN	8 COAST	2		G	A	N	ALWAYS	0	4	
BURNING NETTLE	(WEEDS)	OPAQUE PLASTIC MULCHES	COASTAL	3 NOT APPLICABLE							39	
CABBAGE LOOPER	INSECTS	BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, SEROTYPE 3A,38	COASTAL	2	•	ß		N	ALWAYS	4		
CABBAGE LOOPER	INSECTS	BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, SEROTYPE 3A.3B	S COAST	2		-			-			
CABBAGE LOOPER	INSECTS	BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, SEROTYPE 3A,38	SAN JO	2		G -			ALWAYS		1	
		CONTRACTOR SERVICE SP.35	arm &	•	KILLS BENEFICIAL AND/OR NONTARGET	G		N	ALWAYS	1	1	
CABBAGE LOOPER	INSECTS	CHLORPYRIFOS	COASTAL	2		G		N	ALWAYS	0	1	
CABBAGE LOOPER	INSECTS	CHLORPYRIFOS	S COAST	2		g		N	ALWAYS	8	1	
CABBAGE LOOPER	INSECTS	CHLORPYRIFOS	SAN JO	2	ORGANISMS	G		N	ALWAYS	ρ	1	
CABBAGE LOOPER	INSECTS	ELIMINATE WEED HOSTS	COASTAL	0 OTHER	ADDITIONAL RESEARCH IS NEEDED			- '	NEVER		30	
CABBAGE LOOPER	INSECTS	HYPOSOTER EXIGUA AND A VIRUS. HYPOSOTER EXIGUAE, CODIDOSOMA	COASTAL	0 OTHER	ADDITIONAL RESEARCH IS NEEDED				NEVER	10		
CABBAGE LOOPER	INSECTS	TRUNCATELLUM & NPV.	COASTAL	1	EFFECTIVENESS DEPENDS ON CHEMICAL SPRAY PROGRAM				FREQUENTLY	5	1	
CABBAGE LOOPER	INSECTS	HYPOSOTER EXIGUAE, CODIDOSOMA TRUNCATELLUM & NPV.	COASTAL	1	LESSIVARIABLE EFFECTIVENESS				FREDLENTLY	5	1	

This table lists chemical and non-chemical control methods for the major pests on strawbernes in California. Explanations of the major pests on strawbernes in California. Explanations of the major pests on strawbernes in California. Explanations of the major pests on strawbernes in California. Explanations of the major pests on strawbernes in California. Explanations of the major pests on strawbernes in California. Explanations of the major pests on strawbernes in California. Explanations of the major pests on strawbernes in California. Explanations of the major pests on strawbernes in California. Explanations of the major pests on strawbernes in California. Explanations of the major pests on strawbernes in California. Explanations of the major pests on strawbernes in California.

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				(C)	et planation for	-	1st	2nd	ı Re	Most market	Yield	Bvy	•
Pest	Post type	A) or Control Method	Region	in	g rating of \$	Limitations	Арр	App	sist		red.	•	Coniments
		HYPOSOTER EXIGUAE, CODIDOSOMA				EFFECTIVENESS DEPENDS ON					-	-	
CABBAGE LOOPER	INSECTS	TRUNCATELLUM & NPV.	S COAST	ſ	1	CHEMICAL SPRAY PROGRAM				ALWAYS	1	1	
	*****	HYPOSOTER EXIGUAE, CODIDOSOMA		_									
CABBAGE LOOPER	INSECTS	TRUNCATELLUM & NPV.	S COAST	Ţ	1	LESS/VARIABLE EFFECTIVENESS				ALWAYS	1	1	
CABBAGE LOOPER	INSECTS	HYPOSOTER EXIGUAE, CODIDOSOMA TRUNCATELLUM & NPV.	SAN JO		1	EFFECTIVENESS DEPENDS ON				*****	_	_	-
Organic tool Ex		HYPOSOTER EXIGUAE, CODIDOSOMA	. 00-01-04		•	CHEMICAL SPRAY PROGRAM				ALWAYS	1	1	
CABBAGE LOOPER	INSECTS	TRUNCATELLUM & NPV.	SAN JQ		1	LESSWARIABLE EFFECTIVENESS				ALWAYS		_	•
CITRUS THRPS	NSECTS	PORMETANATE HYDROCHLORIDE	COASTAL		ò					ALMATS	1	1 30	
CITRUS THRIPS	INSECTS	FORMETANATE HYDROCHLORIDE	S COAST		4							1	
	PLANT											•	
COMMON CHICKWEED	(WEEDS)	OPAQUE PLASTIC MULCHES	COASTAL	Ł	3 NOT APPLICABLE							30	
	PLANT												
COMMON GROUNDSEL	(WEEDS)	OPAQUE PLASTIC MULCHES	COASTAL	Ļ	3 NOT APPLICABLE							30	
COMMON LAMBSQUARTERS	PLANT												
COMMON LEAF SPOT (RAMULARIA)	(WEEDS) PATHOGEN	OPAQUE PLASTIC MULCHES BENOMYL	COASTAL		S NOT APPLICABLE		_					30	
COMMON LEAF SPOT (RAMULARIA)	PATHOGEN	BENOMYL	S COASTAL		2 2		G		N	ALWAYS		4	
		Programme .	S COMSI	'	ONLY KNOWN CONTROL WHICH		G		N	ALWAYS		4	
COMMON LEAF SPOT (RAMULARIA)	PATHOGEN	COPPER HYDROXIDE	COASTAL	L		LESS/VARIABLE EFFECTIVENESS	G		N	ALWAYS			
		_ ··· -· ·· 		_	ONLY KNOWN CONTROL WHICH	COLUMNIC DE FEMALES	•	-		ALTINIO	1	4	
COMMON'LEAF SPOT (RAMULARIA)		COPPER HYDROXIDE	S COAST	1	3 IS EFFICACIOUS AGAINST PEST	LESSIVARIABLE EFFECTIVENESS	G	A	N	ALWAYS	1	4	
COMMON LEAF SPOT (RAMULARIA)	PATHOGEN		"COASTAL	L	0 .	<u>-</u> -				- · -	•	30	
COMMON LEAF SPOT (RAMULARIA)	PATHOGEN	ENSURE PLANTING STOCK IS CLEAN.	COASTAL	Ļ	4 OTHER							39	
COMMON LEAF SPOT (RAMULARIA)	PATHOGEN	REMOVE INFECTED LEAVES WHEN PRACTICAL.	COACTA		•	•							
commence are postopical	PAINCAGEN	Production	COASTAL	L	o	KILLS BENEFICIAL AND/OR NONTARGET				•		30	
CORNEARWORM	INSECTS	CHLORPYRIFOS	COASTAL	L	2	ORGANISMS	G		N	FREQUENTLY			
				_	-	KILLS BENEFICIAL AND/OR NONTARGET	•		17	LICECOCHILT	5	1	
CORN EARWORM	INSECTS	CHLORPYRIFOS	S COAST	Γ	2	ORGANISMS	G		N	FREQUENTLY	4	1	
		•				ICLLS BENEFICIAL ANDIOR NONTARGET	_		••		•	٠.	
CORN EARWORM	INSECTS	CHLORPYRIFOS	SAN JO		2	ORGANISMS	G		N	FREQUENTLY	5	1	
CODAL CASSACONA						KILLS BENEFICIAL AND/OR NONTARGET					•	•	
CORN EARWORM	INSECTS	METHOMYL	COASTAL	L	1	ORGANISMS	G		7	ALWAYS	5	1	
CORN EARWORM	INSECTS	METHOMYL			_	KILLS BENEFICIAL AND/OR HONTARGET							
COURT	Maccia	METRONIE	SCOAST		2	ORGANISMS	G		?	FREQUENTLY	5	1	
CORN EARWORM	INSECTS	METHOMYL	SAN JO		1	KILLS BENEFICIAL AND/OR NONTARGET ORGANISMS	_		_		_		
		PLANT VERY EARLY MATURING SWEET	Gran oct		•	CHOMISMS	G		7	ALWAYS	5	1	
CORN EARWORM	INSECTS	CORN AROUND STRAWBERRY FIELDS.	COASTAL	L	0 OTHER	ADDITIONAL RESEARCH IS NEEDED				RARE		36	
		PLANT VERY EARLY MATURING SWEET		-						IOTAL.		-	
CORN EARWORM	INSECTS	CORN AROUND STRAWBERRY FIELDS.	COASTAL	L	0 .	LESSIVARIABLE EFFECTIVENESS				UNKNOWN	7	1	
		PLANT VERY EARLY MATURING SWEET											
CORN EARWORM	INSECTS	CORN AROUND STRAWBERRY FIELDS.	COASTAL	r	0	LOWER YIELD/LOWER GRADE				LINKNOWN	7	1	
CORN EARWORM	INSECTS	PLANT VERY EARLY MATURING SWEET CORN AROUND STRAWBERRY FIELDS.	COASTAL		0	MUST BE USED IN CONJUNCTION WITH				1 10 10 10 10 10 10 10 10 10 10 10 10 10	_		
		PLANT VERY EARLY MATURING SWEET	IAL	-	•	ANOTHER SUBSTANCE OR TACTIC				UNKNOWN	7	1	
CORN EARWORM	INSECTS	CORN AROUND STRAWBERRY FIELDS.	SCOAST	T	0	LESS/VARIABLE EFFECTIVENESS				UNKNOWN	7	1	
_		PLANT VERY EARLY MATURING SWEET									•	•	
CORN EARWORM	INSECTS	CORN AROUND STRAWBERRY FIELDS.	S COAST	T	0	LOWER YIELD/LOWER GRADE				UNKNOWN	?	1	
000M E48M004-		PLANT VERY EARLY MATURING SWEET		_		MUST BE USED IN CONJUNCTION WITH					-	•	
CORN EARWORM	INSECTS	CORN AROUND STRAWBERRY FIELDS.	SCOAST	τ	0	ANOTHER SUBSTANCE OR TACTIC				UNKNOWN	7	1	
CORN EARWORM	INSECTS	PLANT VERY EARLY MATURING SWEET	C441 40		•	. 5-6-14-14-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1							
Control Entrol	4435013	CORN ARCUND STRAWBERRY FIELDS. PLANT VERY EARLY MATURING SWEET	SAN JO		0	LESSIVARIABLE EFFECTIVENESS				UNKNOWN	7	1	
CORN EARWORM	INSECTS	CORN AROUND STRAWBERRY FIELDS.	SAN JO		0	LOWER VIEW OF CHIEF OF A DE					_		
		PLANT VERY EARLY MATURING SWEET	CAMP COL		•	LOWER YIELD/LOWER GRADE MUST BE USED IN CONJUNCTION WITH				UNKNOWN	?	1	
CORN EARWORM	INSECTS	CORN AROUND STRAWBERRY FIELDS.	SAN JO		0	ANOTHER SUBSTANCE OR TACTIC				UNKNOWN	7		
		TRICHOGRAMMA PRETIOSUM & MINUTE			-	THE RESIDENCE OF TACING					1	1	
CORN EARWORM	INSECTS	PIRATE BUG.	COASTAL	ı.	0 OTHER	ADDITIONAL RESEARCH IS NEEDED				RARE		30	
		TRICHOGRAMMA PRETIOSUM & MINUTE				EFFECTIVENESS DEPENDS ON							
CORN EARWORM	INSECTS	PIRATE BUG.	COASTAL	ıL.	0	CHEMICAL SPRAY PROGRAM				UNKNOWN	7	1	
CORN EARWORM	INSECTS	TRICHOGRAMMA PRETIOSUM & MINUTE	COACTE	. 1	n	A CONSTRUCTOR P. PROPERTY AND THE ST					_		
COVIA EVVIACAME	405013	PIRATE BUG. TRICHOGRAMMA PRÉTICSUM & MINUTE	COASTAL	· .	D	LESSVARIABLE EFFECTIVENESS				UNKNOWN	?	1	
CORN EARWORM	INSECTS	PIRATE BUG.	S COAST	т	0	EFFECTIVENESS DEPENDS ON CHEMICAL SPRAY PROGRAM				UNKNOWN	3		
		TRICHOGRAMMA PRETIOSUM & MINUTE			-	and the same of th				~~~~~	?	1	
CORN EARWORM	INSECTS	PIRATE BUG.	S COAST	7	0	LESS/VARIABLE EFFECTIVENESS				UNKNOWN	7	1	
											-	•	

This table lists chemical and non-chemical control methods for the major pasts on strawberries in California. Explanations of

CUTWORMS

INSECTS

AVOID SECOND YEAR PLANTINGS.

ANOTHER SUBSTANCE OR TACTIC

MORE EXPENSIVE

FREQUENTLY

FREQUENTLY

1

niumns is given in the following table. Data is from the 1995 Pest Management Survey Database, wh by DPR and the UF wide IPM Project. Department of Pesticide Regulation -- April 15, 1998 Rat **Explanation** for 1st 2nd Re Meetmarket Yield Svy Pest type Al or Control Mathed Region Fathing of 3 ing Limitations App App sist standards red. -TRICHOGRAMMA PRETIOSUM & MINUTE CORN EARWORM INSECTS PIRATE BUG. S COAST 0 LOWER YIELD/LOWER GRADE LINKNOWN 1 TRICHOGRAMMA PRETIDISLIM & MINESTE **EFFECTIVENESS DEPENDS ON** CORN EARWORM **INSECTS** PIRATE BUG. SAN JO 0 CHEMICAL SPRAY PROGRAM UNKNOWN TRICHOGRAMMA PRETIOSUM & MINUTE CORN EARWORM **INSECTS** PIRATE BUG. SAN JO Ø LESSVARIABLE EFFECTIVENESS LINKNOWN 7 PREDATORS MORE IMPORTANT THAN MUST BE USED IN CONJUNCTION WITH COTTON MELON APHID **INSECTS** PARASITES ANOTHER SUBSTANCE OR TACTIC COASTAL 4 OTHER FREQUENTLY 0 39 PREDATORS MORE IMPORTANT THAN COTTON MELON APHID **INSECTS** PARASITES. COASTAL PREDATORS MORE IMPORTANT THAN COTTON MELON APHID **INSECTS** PARASITES. 5 COAST 4 PREDATORS MORE IMPORTANT THAN COTTON MELON APHID INSECT8 PARASITES. SAN JO ROW COVERS (PLASTIC TUNNELS & COTTON MELON APHID **NSECTS** REMAY-TYPE ENCLOSURESI. COASTAL ٥ ROW COVERS (PLASTIC TUNNELS & COTTON MELON APHID **INSECTS** REMAY-TYPE ENCLOSURES). COASTAL 4 ROW COVERS (PLASTIC TUNNELS & COTTON MELON APHID INSECTS REMAY-TYPE ENCLOSURESI. S COAST 4 ROW COVERS (PLASTIC TUNNELS & COTTON MELON APHID **INSECTS** REMAY-TYPE ENCLOSURES! **SANJQ** CRIBRATE WEEVIL INSECTS AVOID SECOND YEAR PLANTINGS COASTAL 2 MORE EXPENSIVE FREQUENTLY 7 MUST BE USED IN CONJUNCTION WITH CRIBRATE WEEVIL **INSECTS** AVOID SECOND YEAR PLANTINGS COASTAL 2 ANOTHER SUBSTANCE OR TACTIC FREQUENTLY ? CRIBRATE WEEVIL **INSECTS** AVOID SECOND YEAR PLANTINGS S COAST MORE EXPENSIVE FREQUENILY ? MUST BE USED IN CONJUNCTION WITH CRIBRATE WEEVIL **NSECTS** AVOID SECOND YEAR PLANTINGS S COAST 2 ANOTHER SUBSTANCE OR TACTIC FREQUENTLY ? CRIBRATE WEEVIL **INSECTS** AVOID SECOND YEAR PLANTINGS SAN JO MORE EXPENSIVE FREQUENTLY 7 MUST BE USED IN CONJUNCTION WITH CRIBRATE WEEVIL INSECTS AVOID SECOND YEAR PLANTINGS SAN JQ ANOTHER SUBSTANCE OR TACTIC FREQUENTLY 7 CRIBRATE WEEVIL **INSECTS** CHLOROPICRIN COASTAL WORKER SAFETYHANDLING ALWAYS CRIBRATE WEEVIL Ω INSECTS CHLOROPICKIN S COAST 2 WORKER SAFETYHANDLING ALWAYS ۵ CRIBRATE WEEVIL 1 **INSECTS** CHLOROPICRIN DL NAS 2 WORKER SAFETY/HANDLING **ALWAYS** 0 STICKY BARRIERS TO PREVENT CRIBRATE WEEVIL **INSECTS** MOVEMENT OF WEEVILS. COASTAL. ก LESSWARIABLE EFFECTIVENESS UNKNOWN STICKY BARRIERS TO PREVENT CRIBRATE WEEVIL **INSECTS** MOVEMENT OF WEEVILS. COASTAL 0 MORE EXPENSIVE UNICHOWN STICKY BARRIERS TO PREVENT **CRIBRATE WEEVIL INSECTS** MOVEMENT OF WEEVILS. COASTAL PROBLEMS WITH AVAILABILITY UNKNOWN 7 STICKY BARRIERS TO PREVENT **CRIBRATE WEEVIL INSECTS** MOVEMENT OF WEEVILS. COASTAL 0 SIGNIFICANT LABOR REQUIRED UNKNOWN STICKY BARRIERS TO PREVENT MUST BE USED IN CONJUNCTION WITH CRIBRATE WEEVIL INSECTS MOVEMENT OF WEEVILS COASTAL 4 OTHER ANOTHER SUBSTANCE OR TACTIC **ALWAYS** 40 30 STICKY BARRIERS TO PREVENT MOVEMENT OF WEEVILS. CRIBRATE WEEVIL INSECTS S COAST 0 LESSVARIABLE EFFECTIVENESS LINICHCHAN 7 STICKY BARRIERS TO PREVENT CRIBRATE WEEVIL **INSECTS** MOVEMENT OF WEEVILS. S COAST 0 MORE EXPENSIVE UNKNOWN STICKY BARRIERS TO PREVENT CRIBRATE WEEVIL INSECTS MOVEMENT OF WEEVILS. S COAST ٥ PROBLEMS WITH AVAILABILITY UNKNOWN 7 STICKY BARRIERS TO PREVENT CRIBRATE WEEVIL **INSECTS** MOVEMENT OF WEEVILS. S COAST 0 SIGNIFICANT LABOR REQUIRED UNKNOWN 7 STICKY BARRIERS TO PREVENT CRIBRATE WEEVIL **INSECTS** MOVEMENT OF WEEVILS. SAN JO 0 LESSIVARIABLE EFFECTIVENESS UNKNOWN STICKY BARRIERS TO PREVENT CRIBRATE WEEVIL **INSECTS** MOVEMENT OF WEEVILS. SAN JO 0 MORE EXPENSIVE UNKNOWN 7 STICKY BARRIERS TO PREVENT CRIBRATE WEEVIL INSECTS MOVEMENT OF WEEVILS. SAN JO 0 PROBLEMS WITH AVAILABILITY UNKNOWN 7 STICKY BARRIERS TO PREVENT CRIBRATE WEEVIL INSECTS MOVEMENT OF WEEVILS. SAN JQ 0 SIGNIFICANT LABOR REQUIRED UNKNOWN 7 **CUTWORMS** INSECTS AVOID SECOND YEAR PLANTINGS. COASTAL 2 MORE EXPENSIVE SOMETIMES 5 MUST BE USED IN CONJUNCTION WITH **CUTWORMS** INSECTS AVOID SECOND YEAR PLANTINGS. COASTAL 2 ANOTHER SUBSTANCE OR TACTIC SOMETIMES 5 CUTWORMS INSECTS AVOID SECOND YEAR PLANTINGS. SCOAST 2 MORE EXPENSIVE FREQUENTLY t MUST BE USED IN CONJUNCTION WITH CUTWORMS INSECTS AVOID SECOND YEAR PLANTINGS.

S COAST

SAN JO

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ad non-chemical control methods for the major peets on strawberries in California. Explanations of

This table lists cherr

by DPR and the UC

ide iPM Project. Department of Pesticide Regulation—April 15, 1996

arms is given in the following table. Data is from the 1996 Pest Management Survey Database, while

_	••	12' 1880 - Handward London House 12' 1880	•			waste. Date is not non-1990 Pest Mi	mage	nen	t Sun	ty Database, whi		-	норе	يعتمل او
Pest	Post type	Al or Control Method	Region	Rat ing	Explanation for rating of 3	Limitations	18	t 2	nd R	Most market	: Ylek			
CUTWORMS	INSECTS	AVOID SECOND YEAR PLANTINGS.	OL HAS	1		MUST BE USED IN CONJUNCTION WITH ANOTHER SUBSTANCE OR TACTIC		PA	op si	st standards	red.		G	ببدث
CUTWORMS .	NSECTS	BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, SEROTYPE 3A,38	COACTAL	. 2						FREQUENTLY	1	•	1	
CUTWORMS	INSECTS	BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, SEROTYPE 3A,3B		_		LESSWARIABLE EFFECTIVENESS	G		7	FREQUENTLY	10) 3	9	
CUTWORMS	INSECTS	SUBSP. KURSTAKI. SEROTYPE 1A 10	0040741			LESSAVARIABLE EFFECTIVENESS REGULIRES MULTIPLE TREATMENTS OR	G		N	FREQUENTLY	5	; 1	1	•
CUTWORMS	INSECTS	BACILLUS THURINGIENSIS (BERLINER). SUBSP. KURSTAKI SEROTYOE 14 10	\$ COAST	2		APPLICATIONS	G		N	FREQUENTLY	5	i 1	ı	
CUTWORMS	INSECTS	SUBSP. KURSTAKI. SERCTYPE 14 19	8 COAST	2		LESSIVARIABLE EFFECTIVENESS REGULIRES MULTIPLE TREATMENTS OR	G		Ņ	FREQUENTLY	5	i 1	ı	
CUTWORMS	NSECTS	BACILLUS THURINGIENSIS (BERLINER). SUBSP. IGURSTAIG SERCITYDE 34 99	SANJO	2		APPLICATIONS	G		N	FREQUENTLY	5	1	ı	
CUTWORMS	INSECTS	BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, SEROTYPE 3A,38	SANJO	2		LESSVARIABLE EFFECTIVENESS REQUIRES MULTIPLE TREATMENTS OR	G		N	FREQUENTLY	5	1		
CUTWORMS	INSECTS	CARBARYL	COASTAL	_		APPLICATIONS WEAK OR INEFFECTIVE ON	G		N	FREQUENTLY	5	1		
CIPACONA				ONLY M	ETHOD OR MATERIAL	PARTICULAR SPECIES	G		N	FREQUENTLY	1	1		
CUTWORMS	INSECTS	CARBARYL		WHICH	PROVIDES FOR A SHORT	WEAK OR INEFFECTIVE ON								
CUTWORMS	INSECTS	CARBARYL	COASTAL	3 RE-PLAI	NT INTERVAL	PARTICULAR SPECIES								
CUTWORMS	INSECTS	CARBARYL	_ S COAST	2	- · · ·	· · - · · · · · · · · · · · · · · · · ·	G			FREQUENTLY	10	39		
CUTWORMS	INSECTS	CHLOROPICRIN	OL MAR	2		•	G		N	ALWAYS	10			
CUTWORMS			COASTAL	ž	_		G		N	ALWAYS	•	1		
CUTWORMS	INSECTS	CHLOROPICRIN	SCOAST	2	•	WORKER SAFETYHANOLING	Ē		A.		1	1		
	INSECTS	CHLOROPICRIN	SAN JO	5		WORKER SAFETYHANIX ING	ė			ALWAYS	0	1		
CUTWORMS			GP-11 JC2	2		WORKER SAFETYHANDLING	_		N	ALWAYS	0	1		
COMORMS	INSECTS	CHLORPYRIFOS				KILLS BENEFICIAL AND/OR NONTARGET	F		N	ALWAYS	0	1		
CUTWORMS	INSECTS	CHLORPYRIFOS	COASTAL	2		ORGANISMS KILLS BENEFICIAL AND/OR NONTARGET	G		N	ALWAYS	_	1		
CUTWORMS	INSECTS	CHLORPYRIFOS	S COAST	2		URGANISMS	g		N	ALWAYS		-		
CUTWORMS	NSECTS	DIAZINON	SAN JQ	2		KILLS BENEFICIAL AND/OR NONTARGET					•	1		
CUTWORMS	INSECTS		COASTAL	2		ORGANISMS	G		N	ALWAYS				
CUTWORMS		DIAZINON	SCOAST	2			=	A			1	-		
CUTWORMS	INSECTS	DIAZINON	SAN JQ	2			_ ,		•	FREQUENTLY	5	1		
CUTWORMS	INSECTS	METHYL BROWIDE						٨		FREQUENTLY	5	1		
	INSECTS	METHYL BROMIDE	COASTAL	2		WORKER SAFETY/HANDLING	G /	A	7	FREQUENTLY	5	1		
CUTWORMS	INSECTS	METHYL BROMDE	\$ COAST	2		WORKER SAFETYHANDLING	F		N	ALWAYS	ā	1		
CYCLAMEN MITE	INSECTS	AVERMECTIN	OL MAZ	2		WORKER SAFETTRHANDLING	F		N	ALWAYS	ŏ	•		
	4.525.0	VACTOMEC 1 BA	COASTAL	2		WORKER SAFETYHANDLING	F			ALWAYS	-	•		
CYCLAMEN MITE	INSECTS	AVERMECTIN	COASTAL	2		REQUIRES MULTIPLE TREATMENTS OF	G			ALWAYS	0	1		
CYCLAMEN MITE	INSECTS					APPLICATIONS ,	3			A1111200				
CYCLAMEN MITE		AVERMECTIN	COASTAL	2		TEMPERATURE AND/OR SEASONAL	•			ALWAYS	1	1		
	INSECTS	AVERMECTIN	S COAST				_							
CYCLAMEN MITE			a cuns:	2	!		3			ALWAYS	1	1		
CYCLAMEN MITE	INSECTS	AVERMECTIN	S COAST	2	1	REQUIRES MULTIPLE TREATMENTS OR	3			ALWAYS	1	1		
	INSECTS	AVERMECTIN			,	TEMPERATURE AND/OR SEASONAL	3		4	ALWAYS	1	1		
CYCLAMEN MITE	INSECTS	AVERMECTIN	S COAST	2										
			SAN JQ	2		MORE EXPENSIVE	3			NLWAYS	1	4		
CYCLAMEN MITE	INSECTS	AVERMECTIN	SAN JO	2	i	REQUIRES MULTIPLE TREATMENTS OF	3		4	LWAYS	i			
CYCLAMEN MITE	INSECTS	AVERMECTIN AVOID SECOND WELL TO AVOID SECOND WEIGHT WELL TO AVOID SECOND WEIGHT	OL MAS	2	1	APPLICATIONS TEMPERATURE AND/OR SEASONAL	3		-	LWAYS	1	1		
CYCLAMEN MITE	PIOECIS	AVOID SECOND YEAR PLANTINGS IN PROBLEM AREAS.	COASTAL	1 OTHER		DEPENDENCE	3		•	LWAYS	1	1		
CYCLAMEN MITE	#13EC13	AVOID SECOND YEAR PLANTINGS IN PROBLEM AREAS.		2		OWER YIELD/LOWER GRADE			F	PARE		39		
CYCLAMEN MITE	Maccia	AVOID SECOND YEAR PLANTINGS IN PROBLEM AREAS.	COASTAL	_	, N	AORE EXPENSIVE AUST BE USED IN CONJUNCTION WITH			F	REQUENTLY	10	1		
CYCLAMEN MITE	MOECIS :	AVOID SECOND YEAR PLANTINGS IN PROBLEM AREAS.			^	NOTHER SUBSTANCE OR TACTIC			F	REQUENTLY	10	1		
CYCLAMEN MITE	MOEU15	AVOID SECOND YEAR PLANTINGS IN PROBLEM AREAS.		2		IORE EXPENSIVE IUST BE USED IN CONJUNCTION WITH			F	REQUENTLY	10	1 .		
CYCLAMEN MITE	MOEU 15	AVOID SECOND YEAR PLANTINGS IN PROBLEM AREAS.		2	^	NOTHER SUBSTANCE OR TACTIC			FI	REQUENTLY	10	1		
CYCLAMEN MITE		AVOID SECOND YEAR PLANTINGS IN		1	M	IORE EXPENSIVE			_					
CYCLAMEN MITE	MOECIO I	PROBLEM AREAS. DICOFOL		1 .	M A	IUST BE USED IN CONJUNCTION WITH NOTHER SUBSTANCE OR TACTIC				REQUENTLY	10	1		
			OUASIAL.	1	P	OTENTIAL RESISTANCE PROBLEMS G		Y			10 20	1 1		
				Page 6 of	17									

This table lists chemical and non-chemical control methods for the major pasts on strawberries in California. Explanations of the by DPR and the UC S in IPM Protect. Department of Pasticide Regulations April 15, 1998.

nns is given in the following table. Data is from the 1995 Pest Management Survey Database, which

'e IPM Project. Department of Pesticide Regulation - April 15, 1998

Ratutanation for 1st 2nd Re Meet market Pest Post type All or Control Method Region rating of 3 ing Limitations App App sist standards METHOD OR MATERIAL IS NECESSARY TO MANAGE A CYCLAMEN MITE INSECTS DICOFOL. COASTAL 3 PESTICIDE-RESISTANT PEST LESSWARIABLE EFFECTIVENESS FREQUENTLY 10 * CYCLAMEN MITE **INSECTS DICOFOL** S COAST POTENTIAL RESISTANCE PROBLEMS G **ALWAYS** 20 1 CYCLAMEN MITE DICOFOL. **INSECTS** SAN JQ POTENTIAL RESISTANCE PROBLEMS a **ALWAYS** 20 DIP FREEZER TRAYS IN HOT WATER CYCLAMEN MITE **NSECTS** BETWEEN FIELDS. COASTAL 1 OTHER LOWER YIELD/LOWER GRADE RARE 30 DIP FREEZER TRAYS IN HOT WATER CYCLAMEN MITE **INSECTS** BETWEEN PIELDS. COASTAL 2 **LESSIVARIABLE EFFECTIVENESS ALWAYS** 10 DIP FREEZER TRAYS IN HOT WATER BETWEEN FIELDS. CYCLAMEN MITE INSECTS COASTAL MORE EXPENSIVE **ALWAYS** 10 1 OP FREEZER TRAYS IN HOT WATER CYCLAMEN MITE INSECTS BETWEEN FIELDS. S COAST 2 LESSVARIABLE EFFECTIVENESS **ALWAYS** 10 OIP FREEZER TRAYS IN HOT WATER CYCLAMEN MITE INSECTS BETWEEN FIELDS. **S COAST** 2 MORE EXPENSIVE **ALWAYS** 10 OIP FREEZER TRAYS IN HOT WATER CYCLAMEN MITE **INSECTS** BETWEEN FIELDS. SANJO 1 LESSVARIABLE EFFECTIVENESS **ALWAYS** 10 DP FREEZER TRAYS IN HOT WATER CYCLAMEN MITE **INSECTS** BETWEEN FIELDS. **SAN JO** 1 MORE EXPENSIVE **ALWAYS** 10 POTENTIAL GROUND WATER CYCLAMEN MITE **MSECTS ENDOSILIFAN** COASTAL CONTAMINATION **ALWAYS** 10 CYCLAMEN MITE **INSECTS ENDOSULFAN** COASTAL 2 **LESSWARIABLE EFFECTIVENESS** G SOMETIMES 10 POTENTIAL GROUND WATER CYCLAMEN MITE ENDOSULFAN INSECTS S COAST CONTAMINATION G ALWAYS 10 POTENTIAL GROUND WATER CYCLAMEN MITE **INSECTS** ENDOSLILFAN OL MAS 1 CONTAMINATION a N ALWAYS CYCLAMEN MITE **NSECTS** PROPARGITE SAN JO POTENTIALLY PHYTOTOXIC N **ALWAYS** 1 MUST BE USED IN CONJUNCTION WITH CYCLAMEN MITE **INSECTS** USE CLEAN STOCK COASTAL 2 ANOTHER SUBSTANCE OR TACTIC UNKNOWN CYCLAMEN MITE **INSECTS** USE CLEAN STOCK COASTAL 4 OTHER LOWER YIELDILOWER GRADE RARE MUST BE USED IN CONJUNCTION WITH CYCLAMEN MITE INSECTS USE CLEAN STOCK S COAST 2 ANOTHER SUBSTANCE OR TACTIC 1 BAROLOMAN MUST BE USED IN CONJUNCTION WITH CYCLAMEN MITE INSECTS USE CLEAN STOCK **SAN JQ** 2 ANOTHER SUBSTANCE OR TACTIC UNIQUOWN USUALLY NOT EFFECTIVE: TYPHLODROMUS BELLINUS & CYCLAMEN MITE **INSECTS** RETICULATUS COASTAL 1 OTHER LOWER YIELDILOWER GRADE RARE 39 USUALLY NOT EFFECTIVE: TYPHLODROMUS BELLINUS & CYCLAMEN MITE INSECTS RETICULATUS. COASTAL **USUALLY NOT EFFECTIVE:** TYPHLODROMUS BELLINUS & CYCLAMEN MITE **INSECTS** RETICULATUS. 8 COAST USUALLY NOT EFFECTIVE: TYPHLODROMUS RELINUS & CYCLAMEN MITE INSECTS RETICULATUS. OL NAS DESTROY RUBBISH NEAR STRAWBERRY **EUROPEAN EARWIG INSECTS** FIELDS. COASTAL a 30 DESTROY RUBBISH NEAR STRAWBERRY **EUROPEAN EARWIG** INSECTS FIELDS: COASTAL 2 MORE EXPENSIVE FREQUENTLY DESTROY RUBBISH NEAR STRAWBERRY **EUROPEAN EARWIG INSECTS** FIELDS: S COAST 2 MORE EXPENSIVE FREQUENTLY DESTROY RUBBISH NEAR STRAWBERRY ELIROPEAN EARWIG **NSECTS** PIELOS. SAN JO • MORE EXPENSIVE FREQUENTLY PLANT FILAREE (WEEDS) **OPAQUE PLASTIC MULCHES** COASTAL 3 NOT APPLICABLE FOLIAR NEMATODE (APHELENCHOIDES FRAGARIAE) NEMATODES CERTIFIED PLANTING STOCK COASTAL 4 OTHER 30 FOLIAR NEMATODE HOT WATER TREATMENT OF PLANTING (APHELENCHOIDES FRAGARIAE) NEMATODES STOCK COASTAL 3 OTHER 30 STICKY BARRIERS TO PREVENT **FULLER ROSE BEETLE** INSECTS MOVEMENT OF WEEVILS. COASTAL 0 LESSWARIABLE EFFECTIVENESS LINIONOWN 7 STICKY BARRIERS TO PREVENT FULLER ROSE BEETLE INSECTS MOVEMENT OF WEEVILS. COASTAL MORE EXPENSIVE UNKNOWN STICKY BARRIERS TO PREVENT FULLER ROSE BEETLE **INSECTS** MOVEMENT OF WEEVILS. COASTAL Ω PROBLEMS WITH AVAILABILITY UNKNOWN STICKY BARRIERS TO PREVENT **FULLER ROSE BEETLE NSECTS** MOVEMENT OF WEEVILS. COASTAL ٥ SIGNIFICANT LABOR REQUIRED UNKNOWN

Major pests and their methods of cr

's strawberries in California, from a survey

This table fists c ty DPR and the land non-chemical control methods for the major peets on strawberries in California. Explanation. by DPR and the land an invited IPM Project. Department of Peeticide Regulation—April 15, 1998.

columns is given in the following table. Data is from the 1998 Pest Management Survey Database, whice was developed jointly

Explanation for 1st 2nd Re Most market Yield Say Post Pest type A) or Control Method Region rating of 2 1 Imitations App App sist standards red. STICKY BARRIERS TO PREVENT MUST BE USED IN CONJUNCTION WITH **PULLER ROSE BEETLE INSECTS** MOVEMENT OF WEEVILS, ANOTHER SUBSTANCE OR TACTIC COASTAL 4 OTHER **ALWAYS** 40 39 STICKY BARRIERS TO PREVENT **FULLER ROSE BEETLE NSECTS** MOVEMENT OF WEEVILS. S COAST Ď LESSIVARIABLE EFFECTIVENESS LINKNOMN ? 1 STICKY BARRIERS TO PREVENT FULLER ROSE BEETLE **INSECTS** MOVEMENT OF WEEVILS. S COAST ۵ MORE EXPENSIVE LINKNOWN STICKY BARRIERS TO PREVENT FULLER ROSE BEETLE MOVEMENT OF WEEVILS. **INSECTS** S COAST PROBLEMS WITH AVAILABILITY 0 UNIONOWN 7 1 STICKY BARRIERS TO PREVENT FULLER ROSE BEETLE MOVEMENT OF WEEVILS. **NSECTS** S COAST 0 SIGNIFICANT LABOR REQUIRED UNKNOWN 7 CONTINUOS FLOODING FOR THREE **INSECTS** GARDEN SYMPHYLAN WEEKS IN THE SUMMER. COASTAL ß -CONTINUOS FLOODING FOR THREE GARDEN SYMPHYLAN . **NSECTS** WEEKS IN THE SUMMER. COASTAL ADDITIONAL RESEARCH IS NEEDED UNKNOWN 7 CONTINUOS FLOODING FOR THREE GARDEN SYMPHYLAN **NSECTS** WEEKS IN THE SUMMER. S COAST ADDITIONAL RESEARCH IS NEEDED UNKNOWN 7 CONTINUOS PLOODING FOR THREE GARDEN SYMPHYLAN **INSECTS** WEEKS IN THE SUMMER. SAN JO ADDITIONAL RESEARCH IS NEEDED UNKNOWN 7 1 GARDEN SYMPHYLAN INSECTS DISKING IN A CROP OF SORGHUM. COASTAL 0 GARDEN SYMPHYLAN DISKING IN A CROP OF SORGHUM. **NSECTS** COASTAL ADDITIONAL RESEARCH IS NEEDED LINKNOWN GARDEN SYMPHYLAN 2 **INSECTS** DISKING IN A CROP OF SORGHUM. S COAST ADDITIONAL RESEARCH IS NEEDED UNKNOWN 7 GARDEN SYMPHYLAN **INSECTS** DISIGNG IN A CROP OF SORGHUM. SAN JO **ADDITIONAL RESEARCH IS NEEDED** UNKNOWN GARDEN TORTRIX 7 **INSECTS** AVOID SECOND YEAR PLANTINGS. COASTAL MORE EXPENSIVE FREQUENTLY 1 MUST BE USED IN CONJUNCTION WITH GARDEN TORTRIX **INSECTS** AVOID SECOND YEAR PLANTINGS. COASTAL ANOTHER SUBSTANCE OR TACTIC FREQUENTLY GARDEN TORTROX **INSECTS** AVOID SECOND YEAR PLANTINGS. SCOAST MORE EXPENSIVE FREQUENTLY 1 1 MUST BE USED IN CONJUNCTION WITH GARDEN TORTRIX INSECTS AVOID SECOND YEAR PLANTINGS. SCOAST ANOTHER SUBSTANCE OR TACTIC FREQUENTLY GARDEN TORTROX **INSECTS AVOID SECOND YEAR PLANTINGS** SAN JO MORE EXPENSIVE **ALWAYS** Ð 1 MUST BE USED IN CONJUNCTION WITH **GARDEN TORTRIX** INSECTS AVOID SECOND YEAR PLANTINGS. SAN JO ANOTHER SUBSTANCE OR TACTIC **ALWAYS** GARDEN TORTROX 0 1 **INSECTS ELIMINATE WEED HOSTS** COASTAL DOTHER ADDITIONAL RESEARCH IS NEEDED NEVER **GARDEN TORTROX** ťΩ 30 **INSECTS** HYPOSOTER EXIGUA AND A VIRUS. COASTAL Q OTHER ADDITIONAL RESEARCH IS NEEDED NEVER 10 30 REMOVE ACCUMULATED TRASH IN **GARDEN TORTRIX INSECTS** SPRING. COASTAL SIGNIFICANT LABOR REQUIRED **FREQUENTLY** 5 REMOVE ACCUMULATED TRASH IN **GARDEN TORTRIX INSECTS** SPRING. SCOAST SIGNIFICANT LABOR REQUIRED FREQUENTLY, 5 1 REMOVE ACCUMULATED TRASH IN GARDEN TORTRIX INSECTS SPRING. **SAN JO** SIGNIFICANT LABOR REQUIRED **ALWAYS** 0 1 PREDATORS MORE IMPORTANT THAN **EFFECTIVENESS DEPENOS ON GREEN PEACH APHID** INSECTS PARASITES. CHEMICAL SPRAY PROGRAM COASTAL 1 SOMETIMES 5 1 PREDATORS MORE IMPORTANT THAN MUST BE USED IN CONJUNCTION WITH **GREEN PEACH APHIO** INSECTS PARASITES. COASTAL ANOTHER SUBSTANCE OR TACTIC SOMETIMES 5 1 PREDATORS MORE IMPORTANT THAN MUST BE USED IN CONJUNCTION WITH **GREEN PEACH APHID INSECTS** PARASITES. COASTAL 4 OTHER ANOTHER SUBSTANCE OR TACTIC FREQUENTLY 0 39 PREDATORS MORE IMPORTANT THAN EFFECTIVENESS DEPENDS ON GREEN PEACH APHIO **INSECTS** PARASITES. S COAST 1 CHEMICAL SPRAY PROGRAM SOMETIMES 5 1 PREDATORS MORE IMPORTANT THAN MUST BE USED IN CONJUNCTION WITH GREEN PEACH APHID **INSECTS** PARASITES. S COAST 1 ANOTHER SUBSTANCE OR TACTIC SOMETIMES 5 1 PREDATORS MORE IMPORTANT THAN **EFFECTIVENESS DEPENDS ON GREEN PEACH APHID** INSECTS PARASITES. SAN JO CHEMICAL SPRAY PROGRAM SOMETIMES 1 1 PREDATORS MORE IMPORTANT THAN MUST BE USED IN CONJUNCTION WITH **GREEN PEACH APHID** INSECTS PARASITES. SAN JO ANOTHER SUBSTANCE OR TACTIC SOMETIMES 1 1 ROW COVERS (PLASTIC TUNNELS & GREEN PEACH APHID INSECTS REMAY-TYPE ENCLOSURES). COASTAL 0 MORE EXPENSIVE **ALWAYS** 7 ROW COVERS (PLASTIC TUNNELS & MUST BE USED IN CONJUNCTION WITH **GREEN PEACH APHID** INSECTS REMAY-TYPE ENCLOSURES). COASTAL a ANOTHER SUBSTANCE OR TACTIC **ALWAYS** 7 1 ROW COVERS (PLASTIC TUNNELS & **GREEN PEACH APHID** INSECTS REMAY-TYPE ENCLOSURES). COASTAL 0 30 ROW COVERS (PLASTIC TUNNELS & **GREEN PEACH APHID NSECTS** REMAY-TYPE ENCLOSURES). S COAST ۵ MORE EXPENSIVE **ALWAYS** 7 ROW COVERS (PLASTIC TUNNELS & MUST BE USED IN CONJUNCTION WITH **GREEN PEACH APHID** INSECTS REMAY-TYPE ENCLOSURES). S COAST ٥ ANOTHER SUBSTANCE OR TACTIC **ALWAYS** 7 ROW COVERS (PLASTIC TUNNELS & **GREEN PEACH APHID INSECTS** REMAY-TYPE ENCLOSURES). SAN JO MORE EXPENSIVE **ALWAYS** 7 ROW COVERS (PLASTIC TUNNELS & MUST BE USED IN CONJUNCTION WITH **GREEN PEACH APHID** INSECTS REMAY-TYPE ENCLOSURES). SAN JQ a ANOTHER SUBSTANCE OR TACTIC ALWAYS 7

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This table lists chemical and non-chemical control methods for the major posts on strawberries in California. Explanations of olumns is given in the following table. Data is from the 1998 Pest Management Survey Database, who by DPR and the U" would IPM Project. Department of Pesticide Regulation—April 15, 1998

by DHR and the UP Townse IPM Pro	siect Debattme	nt of Pesticide Regulation April 15, 1995			•					:		. ` '
	Pest type	Al or Portant Station		Rat explanation for					Most market	Yleid	Sv	,
•	PLANT	Al or Control Method	Region	ing rating of 3	Limitations	App	App	Sist	standerde	194	-	Солиция
HAIRY NIGHTSHADE	(WEEDS)	OPAQUE PLASTIC MULCHES	COASTAL	3 NOT APPLICABLE	•						_	•
	(3	•
		FOR SUMMER PLANTED, TOPPING IN										
IRIS WHITEFLY	INSECTS	SPRING CAN REDUCE OW POPULATIONS.	COASTAL.	o c	MORE EXPENSIVE				ALWAYS	7		1
		·			,					•		•
Marie and the Marie and the		FOR SUMMER PLANTED, TOPPING IN										
IRIS WHITEFLY	NSECTS	SPRING CAN REDUCE OW POPULATIONS.	SCOAST	1	MORE EXPENSIVE				ALWAYS	3		1
		FOR SUMMER PLANTED, TOPPING IN										
IRIS WHITEFLY	INSECTS	SPRING CAN REDUCE OW POPULATIONS	SAN JO	Q	MORE EXPENSIVE				ALLACAVA			
			—	•	EFFECTIVENESS DEPENDS ON				ALWAYS	\$		1
RIS WHITEFLY	INSECTS	MANY PARASITES & PREDATORS.	COASTAL	0	CHEMICAL SPRAY PROGRAM				LINKNOWN	7		1
					EFFECTIVENESS DEPENDS ON					-		•
IRIS WHITEFLY	INSECT8	MANY PARASITES & PREDATORS.	8 COAST	1	CHEMICAL SPRAY PROGRAM				UNKNOWN	7		1
IRES WHATEFLY	INSECTS	MANY PARASITES & PREDATORS.	SANJO	2	EFFECTIVENESS DEPENOS ON					_		
	100013	HEATT FREGULES & FREDRICKS.	24134	4	CHEMICAL SPRAY PROGRAM				UNICHOWN	7		1
		AVOID FIELDS WITH WET SATURATED										
LEATHER ROT (PHYTOPHITHORA)	PATHOGEN	CONDITIONS. NO OVERHEAD IRRIGATION.	COASTAL	1	ADDMONAL RESEARCH IS NEEDED				RARE	•	3	2
				ONLY KNOWN CONTROL WHICH	ł				1000	•		•
LEATHER ROT (PHYTOPHITHORA)	PATHOGEN	METALAXYL	COASTAL	3 IS EFFICACIOUS AGAINST PEST		G		N	ALWAYS			4
LEATHER ROT PHYTOPHTIHORAL	PATHOGEN	METALAXYL	S COAST	ONLY KNOWN CONTROL WHICH 3 IS EFFICACIOUS AGAINST PEST								
estimation from the money		me product	SWASI	3 IS ETTICALIOUS AUAMS (PESI	KILLS BENEFICIAL AND/OR NONTARGET	G		H	ALWAYS			4
LEATHER ROT (PHYTOPHTTHORA)	PATHOGEN	METHYL BROWDE	COASTAL	4	ORGANISMS	G		N	ALWAYS			4
				•	KILLS BENEFICIAL AND/OR MONTARGET			**	HUTTATO	•	,	•
LEATHER ROT (PHYTOPHITHORA)	PATHOGEN	METHYL BROWIDE	S COAST	A	ORGANISMS	G		N	ALWAYS	1		4
LEATHER ROT (PHYTOPHITHORA) LEATHER ROT (PHYTOPHITHORA)	PATHOGEN	PLASTIC MULCHES.	COASTAL	1 .	ADDITIONAL RESEARCH IS NEEDED				RARE		3	
LEXINER ROT (FITTOFFITTION)	PATHOGEN	REMOVE DISEASED FRUIT. SELECT FIELDS ISOLATED FROM	COASTAL	1 -	ADDITIONAL RESEARCH IS NEEDED				RARE	•	5 3	9
LEATHER ROT (PHYTOPHITHORA)	PATHOGEN	CONVENTIONAL GROWING AREAS	COASTAL	a	ADDITIONAL RESEARCH IS NEEDED				0400		· .	_
	PLANT			•	VACUIDANT INTERPRETATION IS MEETING				RARE	•	3	•
LITTLE MALLOW	(WEEDS)	OPAQUE PLASTIC MULCHES	COASTAL	3 NOT APPLICABLE							3	a
LYGUS BUG	INSECTS	CHLOROPICRIN	COASTAL	0							3	
LYGUS BUG	INSECTS	CONTROL WEEDS WITHIN AND AROUND THE FIELD.	COASTAL	•	Annual Change Change							
2.000.200		CONTROL WEEDS WITHIN AND AROUND	COASIAL	2	MORE EXPENSIVE MUST BE USED IN CONJUNCTION WITH				SOMETIMES	2)	1
LYGUS BUG	NSECTS	THE FIELD.	COASTAL	2	ANOTHER SUBSTANCE OR TACTIC				SOMETIMES	~	-	•
		CONTROL WEEDS WITHIN AND AROUND			The state of the s				OCHRE I MIES	2	,	1
Lygus Bug	INSECTS	THE FIELD.	3 COAST	1	MORE EXPENSIVE				SOMETIMES	2	3	1
LYGUS BUG	INSECTS	CONTROL WEEDS WITHIN AND AROUND			MUST BE USED IN CONJUNCTION WITH					_	_	•
LTG03 903	#ISEC1S	THE FIELD. CONTROL WEEDS WITHIN AND AROUND	S COAST	1	ANOTHER SUBSTANCE OR TACTIC				SOMETIMES	2)	1
LYGUS BUG	INSECTS	THE FIELD.	SAN JO	٥	MORE EXPENSIVE					_	_	_
		CONTROL WEEDS WITHIN AND AROUND		· ·	MUST BE USED IN CONJUNCTION WITH				SOMETIMES	2	3	1
LYGUS B UG	INSECTS	THE FIELD.	SAN JO	D .	ANOTHER SUBSTANCE OR TACTIC				SOMETIMES	2		1
1 101 10 01 10	*105050	Para des amos a			MUST BE USED IN CONJUNCTION WITH					-	-	•
LYGUS BUG	INSECTS	DIAZINON	COASTAL	1	ANOTHER SUBSTANCE OR TACTIC	G	A	7	SOMETIMES	2	0	1
LYGUS BUG	INSECTS	DIAZINON	COASTAL	1	REQUIRES MULTIPLE TREATMENTS OR	_		_	-		_	
				•	APPLICATIONS WEAK OR INEFFECTIVE ON	G	A	7	SOMETIMES	2	D	1
LYGUS BUG	INSECTS	DIAZINON	COASTAL	1	PARTICULAR SPECIES	G	A	7	SOMETIMES	2		•
					MUST BE USED IN CONJUNCTION WITH	•		•		-	•	1
LYGUS BUG	INSECTS	DIAZNON	SAN JQ	1	ANOTHER SUBSTANCE OR TACTIC	G	A	7	SOMETIMES	2	0	1
LYGUS BUG	MICCOTO	(NAZNIO)		,	REQUIRES MULTIPLE TREATMENTS OR					_	-	
LIGHS BUS	INSECTS	DIAZINON	SAN JO	1	APPLICATIONS	G	A	7	SOMETIMES	2	3	1
LYGUS BUG	INSECTS	DIAŽINON	SAN JO	1	WEAK OR INSTRECTIVE ON	_		_				_
LYGUS BUG	INSECTS	MALATHON	COASTAL	ž	PARTICULAR SPECIES LESS/VARIÁBLE EFFECTIVENESS	G	٨		SOMETIMES	2		1
		•		_	REQUIRES MULTIPLE TREATMENTS OR	G		7	SOMETIMES	2	3 3	• ,
LYGUS BUG	INSECTS	MALATHION	COASTAL	2	APPLICATIONS	G		Y	SOMETIMES	2	3	1
TAGNZ BNG	INSECTS	MALATHION	COASTAL	2	SHORT OR NO RESIDUAL	Ğ			SOMETIMES	ž		i
LYGUS BUG	INSECTS	MALATHON	0.00467	•	REQUIRES MULTIPLE TREATMENTS OR	_						
LYGUS BUG	INSECTS	MALATHON	S COAST	2 2	APPLICATIONS SHORT OR NO RESIDUAL	G			SOMETIMES	2		1
			Junui	-	REQUIRES MULTIPLE TREATMENTS OR	G		Y	SOMETIMES	2	,	1
LYGUS BUG	INSECTS	MALATHION	SAN JO	2	APPLICATIONS	G		Y	SOMETIMES	20)	1
						-		-		_		

This table lists chemical and non-chemical control methods for the major pasts on strawberries in California. Explanations rolumns is given in the following table. Data is from the 1995 Pest Management Survey Database, w by DPR and the tewide IPM Project. Department of Pesticide Regulation-April 15, 1998 -Explanation for tet 2nd Ro Mostmarket Yould Day ìng Peat tree Al of Control Method Region I Indiadiona rating of \$ App App slot standards an Com LYGUS BUG MALATHON **INSECTS** SAN JO SHORT OR NO RESIDUAL SOMETIMES Ω 20 1 MANY PREDATORS ON THE NYMPHAL INSECTS LYGUS BUG STACE COASTAL LESSWARIABLE EFFECTIVENESS RARE 20 MANY PREDATORS ON THE NYMPHAL LYGUS BUG **NSECTS** STAGE COASTAL LOW THRESHOLD FOR DAMAGE RARE 20 MANY PREDATORS ON THE NYMPHAL. MUST BE USED IN CONJUNCTION WITH LYGUS BUG **NSECTS** STAGE COASTAL 1 ANOTHER SUBSTANCE OR TACTIC RARE 20 MANY PREDATORS ON THE NYMPHAL LYGUS BUG **INSECTS** STAGE S COAST LESSIVARIABLE EFFECTIVENESS **HEROTENITA** 20 MANY PREDATORS ON THE NYMPHAL **INSECTS** LYOUS BUG STAGE S COAST LOW THRESHOLD FOR DAMAGE PREDLEMILY 20 MANY PREDATORS ON THE NYMPHAL MUST BE USED IN CONJUNCTION WITH LYGUS BUG **NSECTS** STAGE. S COAST 1 ANOTHER SUBSTANCE OR TACTIC FREQUENTLY 20 MANY PREDATORS ON THE NYMPHAL LYGUS BUG **NSECTS** RTAGE SAN JO LESSWARIABLE EFFECTIVENESS FREDLIENS Y 20 MANY PREDATORS ON THE NYMPHAL LYGUS BUG INSECTS STAGE LOW THRESHOLD FOR DAMAGE SAN JO FREQUENTLY 20 MANY PREDATORS ON THE NYMPHAL MUST BE USED IN CONJUNCTION WITH LYGUS BUG **MSECTS** STAGE SAN JO 1 ANOTHER SUBSTANCE OR TACTIC FRECLIENTLY 20 KILLS BENEFICIAL AND/OR NONTARGET LYGUS BUG **INSECTS** METHOMYL COASTAL 2 ORGANISMS SOMETIMES 10 METHOD OR MATERIAL IS NECESSARY TO MANAGE A REQUIRES MULTIPLE TREATMENTS OR LYGUS BUG **INSECTS** METHOMYL COASTAL 3 PESTICIDE-RESISTANT PEST **APPLICATIONS** SOMETIMES 10 30 KILLS BENEFICIAL AND/OR NONTARGET LYGUS BUG NSECTS METHOMYL SAN JO **ORGANISMS** FREQUENTLY 10 1 LYGUS BUG **INSECTS** METHYL BROWDE COASTAL 0 LYGUS BUG **NSECTS MEVINPHOS** COASTAL. 0 30 MOW OR DISC UNDER COVER CROPS MUST BE USED IN CONJUNCTION WITH LYGUS BUG **INSECTS** BEFORE THEY FLOWER. COASTAL 2 ANOTHER SUBSTANCE OR TACTIC SOMETIMES 20 MOW OR DISC LINDER COVER CROPS TEMPERATURE AND/OR SEASONAL LYGUS BUG **INSECTS** BEFORE THEY FLOWER. COASTAL 2 DEPENDENCE SOMETIMES 70 MOW OR DISC UNDER COVER CROPS MUST BE USED IN CONJUNCTION WITH LYGUS BUG INSECTS BEFORE THEY FLOWER S COAST ANOTHER SUBSTANCE OR TACTIC SOMETIMES 20 MOW OR DISC UNDER COVER CROPS TEMPERATURE AND/OR SEASONAL LYGUS BUG INSECTS BEFORE THEY FLOWER. SCOAST DEPENDENCE SOMETIMES 20 1 MOW OR DISC UNDER COVER CROPS MUST BE USED IN CONJUNCTION WITH LYGUS BLIG INSECTS BEFORE THEY FLOWER. SAN JQ Λ ANOTHER SUBSTANCE OR TACTIC SOMETIMES 20 MOW OR DISC UNDER COVER CROPS TEMPERATURE AND/OR SEASONAL LYGUS BUG **INSECTS** BEFORE THEY FLOWER. SAN JO O DEPENDENCE SOMETIMES 20 KILLS BENEFICIAL AND/OR NONTARGET LYGUS BUG INSECTS NALED COASTAL 2 **ORGANISMS** a SOMETIMES 20 WEAK OR INEFFECTIVE ON LYGUS BUG INSECTS NALED COASTAL PARTICULAR SPECIES 2 ß SOMETIMES 10 39 KILLS BENEFICIAL AND/OR NONTARGET LYGUS BUG **INSECTS** NAI ED SANJO ORGANISMS ß FREQUENTLY 10 LYGUS BUG INSECTS PETROLEUM DISTILLATES, AROMATIC COASTAL LESSVARIABLE EFFECTIVENESS 2 G SOMETIMES 10 39 LYGUS BUG **INSECTS PYRETHRINS** COASTAL 0 LESSWARIABLE EFFECTIVENESS G SOMETMES 20 1 LYGUS BUG INSECTS **PYRETHRINS** COASTAL LOWER YIELD/LOWER GRADE G SOMETIMES 20. 1 LYGUS BUG **INSECTS PYRETHRINS** COASTAL MORE EXPENSIVE SOMETIMES 20 REQUIRES MULTIPLE TREATMENTS OR LYGUS BUG **INSECTS PYRETHRINS** COASTAL a APPLICATIONS SOMETIMES 20 LYGUS BUG INSECTS **PYRETHRINS** S COAST LESSIVARIABLE EFFECTIVENESS 0 SOMETIMES G 20 1 LYGUS BUG **INSECTS PYRETHRINS** S COAST 0 LOWER YIELD/LOWER GRADE a SYMETRIES 20 1 LYGUS BUG **INSECTS PYRETHRINS** S COAST 0 MORE EXPENSIVE a SOMETIMES 20 REQUIRES MULTIPLE TREATMENTS OR LYGUS BUG **INSECTS PYRETHRINS** SCOAST Ω **APPLICATIONS** G SOMETIMES 20 I YGUS BUG INSECTS **PYRETHRINS** SAN JO n LESSVARIABLE EFFECTIVENESS G SOMETMES 20 1 INSECTS LYGUS BUG **PYRETHRINS** SAN JO 0 LOWER YIELD/LOWER GRADE G SOMETIMES 20 1 LYGUS BUG INSECTS **PYRETHRINS** SAN JO ٥ MORE EXPENSIVE SOMETIMES 20 REQUIRES MULTIPLE TREATMENTS OR LYGUS BUG **INSECTS PYRETHRINS** SAN JO Ω APPLICATIONS B SOMETIMES 20 1 COASTAL LYGUS BUG INSECTS SUCTION DEVICES LESS/VARIABLE EFFECTIVENESS SOMETIMES 20 SUCTION DEVICES. LYGUS BUG INSECTS COASTAL MORE EXPENSIVE SOMETIMES 20 MUST BE USED IN CONJUNCTION WITH SUCTION DEVICES. LYGUS BUG INSECTS COASTAL 1 ANOTHER SUBSTANCE OR TACTIC SOMETIMES 20 LYGUS BUG INSECTS SUCTION DEVICES SICOAST a LESSVARIABLE EFFECTIVENESS SOMETIMES 20 1 LYGUS BUG **INSECTS SUCTION DEVICES** S COAST MORE EXPENSIVE SOMETIMES 20

Major pests and their methods of control in

whereign California, from a survey

This table lists chamics non-chemical control methods for the major pests on strawberries in California. Explanations of the by DPR and the UCS IPM Project. Department of Pasticide Regulation—April 15, 1998

is is given in the following table. Data is from the 1998 Pest Management Survey Detaines, which we

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Major pests and their methods of corr "'s strawberries in California, from a survey This table lists of t and non-chemical control methods for the major pests on strawberries in California. Explanations service IPM Project. Department of Pesticide Regulation—April 15, 1998 solumns is given in the following table. Data is from the 1995 Pest Management Survey Database, wit. by DPR and the

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This table fiets chemical and non-chemical control methods for the major pests on strawberries in Celifornia. Explanations of ' smna is given in the following table. Data is from the 1998 Pest Management Survey Detabase, which by DPR and the UC ide IPM Project. Department of Pesticide Regulation—April 15, 1995

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"d non-chemical control methods for the major pests on strawberries in California. Explanations of (
de IPM Project. Department of Pesticide Regulation—And 15, 1998.

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SIGNIFICANT LABOR REQUIRED

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The INC Statement (1996 Peat Management Survey Database

APPENDIX 3



University of California: Statewide Integrated Past Management Project

UC Pest Management Guidelines

STRAWBERRY

ANGULAR LEAF SPOT

Pathogen: Xanthomonas fragariae (Reviewed: 08/95, updated: 05/91)



SYMPTOMS

COMMENTS ON THE DISEASE

COMMENTS ON CONTROL

CULTURAL CONTROL

ORGANICALLY ACCEPTABLE METHODS

WHEN TO TREAT

TREATMENT

PUBLICATION

GLOSSARY



SYMPTOMS:

Infection first appears as minute, <u>water-soaked spots [92K]</u> on the lower surface of leaves. The lesions enlarge to form translucent, angular spots that are delineated by small veins and often exude a viscous ooze, which appears as a whitish and scaly film after drying. As the disease progresses, <u>lesions [95K]</u> coalesce and reddish brown spots, which later become necrotic, appear on the upper surface of the leaves. A chlorotic halo usually surrounds the infected area.

COMMENTS ON THE DISEASE:

This bacterium is not free living in soil. It can, however, overwinter in soil on previously infected plant material. Transmission is by splashing water. It is host specific and highly resistant to degradation - it can persist in the soil for long periods of time. It is killed by methyl bromide/chloropicrin mixture used as a preplant furnigant, so it is very likely that most initial infections in fields that have been furnigated originate from contaminated plants. Lesions on the leaf surface serve as a source for secondary inoculum and cells are dispersed by splashing rain or overhead irrigation. The disease is favored by cool, moist days with cold nights near freezing.

Although uncommon in California, Xanthomonas fragariae can cause vascular collapse. This symptom initially appears as a water-soaked area at the base of newly emerged leaves. Shortly after, the whole plant suddenly dies, much like plants infected with crown rot.

COMMENTS ON CONTROL:

Chemical controls are typically ineffective against this pathogen. Copper containing compounds are registered but have caused phytotoxicity with repeated applications. Preplant fumigate with methyl bromide/chloropicrin mixture.

CULTURAL CONTROL:

Use clean planting stock and avoid overhead irrigation when possible.

ORGANICALLY ACCEPTABLE METHODS:

Cultural controls.

WHEN TO TREAT:

Chemical controls are generally not cost effective.

TREATMENT:

Pesticide Amount/Acre** P.H.I.+ Comments (commercial name) (days)

A. FIXED COPPERS# Label rates

Repeat applications may be phytotoxic to plants.

- ** Apply all materials in 200 gal water/acre to ensure adequate coverage.
- * Permit required from county agricultural commissioner for purchase or use.
- + Preharvest interval. Do not apply within this many days of harvest.

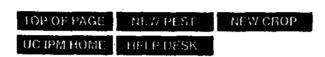
PRECAUTIONS

PUBLICATION:

UC IPM Pest Management Guidelines: Strawberry

D. Gubler

UC DANR Publication 3339



Statewide IPM Project, Division of Agriculture and Natural Resources, University of California

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HTML Revised: April 15, 1996

Please e-mail your comments to: ipmig@ucdavis.edu



University of California Statewide integrated Peet Management Project

UC Pest Management Guidelines

STRAWBERRY

ANTHRACNOSE

Pathogen: Colletotrichum acutatum

(Reviewed: 08/95, updated: 08/95)



SYMPTOMS

COMMENTS ON THE DISEASE

COMMENTS ON CONTROL

CULTURAL CONTROL

ORGANICALLY ACCEPTABLE CONTROLS

WHEN TO TREAT

TREATMENT

PUBLICATION

GLOSSARY



SYMPTOMS:

Dark elongated fusiform lesions [63K] appear on petioles and runners, and often girdle the stem. On fruit, light tan to light brown water-soaked lesions [80K] develop and turn into sunken black lesions. Both ripe and unripe fruit can be affected. Wilting or dying plants [72K] infected with Anthracnose crown rot tend to have a red to brown streaking [74K] in the interior of the crown.

COMMENTS ON THE DISEASE:

Warm or cool, wet conditions favor the development of fruit and stem rot. Fungus overwinters in plant debris or alternate weed hosts.

COMMENTS ON CONTROL:

Use protective fungicides such as benomyl or captan. Disease is most common on varieties that fruit in the nursery. Contamination may occur in fruit production fields as a result of nursery infections or contamination of planting material.

CULTURAL CONTROL:

Use drip or furrow irrigation and clean planting stock.

ORGANICALLY ACCEPTABLE CONTROLS:

Cultural controls.

WHEN TO TREAT:

Treat in nurseries when day neutral varieties begin to fruit. Treat in fields before an expected rain.

TREATMENT:

Pesticide

Amount/Acre** P.H.I.+ Comments

(commercial name)

A. BENOMYL

(Benlate)

1 lb

...PLUS...

CAPTAN 50WP 4 lb

COMMENTS: Do not apply in combination with, immediately before, or closely following oil sprays.

** Apply all materials in 200 gal water/acre to ensure adequate coverage.

+ Preharvest interval. Do not apply within this many days of harvest.

PRECAUTIONS

PUBLICATION:

UC IPM Pest Management Guidelines: Strawberry

D. Gubler

UC DANR Publication 3339

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Statewide IPM Project, Division of Agriculture and Natural Resources, University of California

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Please e-mail your comments to: ipmig@ucdavis.edu